RECORD OF DECISION

FIVE POINTS PCE PLUME NPL SITE

Woods Cross/Bountiful, Davis County, Utah

Prepared By:

Utah Department of Environmental Quality
Division of Environmental Response and Remediation

For:
United States Environmental Protection Agency
Region 8
1595 Wynkoop
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DECLARATION OF THE RECORD OF DECISION

Site Name and Location

The Five Points PCE Plume National Priorities List (NPL) site (Site) is located at approximately 1500 South and State Highway 106 in Woods Cross/Bountiful, Davis County, Utah (Figure 1). The U.S. Environmental Protection Agency (EPA) Site Identification Number is UT0008921894.

Statement of Basis and Purpose

This decision document presents the selected remedy for the Five Points PCE Plume Site. The selected remedy has been chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, 42 U.S. Code (USC) §9601 *et. seq.* as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record for the Five Points PCE Plume Site.

The State of Utah through the Department of Environmental Quality (UDEQ) concurs with the selected remedy.

Assessment of the Site

The response action selected in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants or contaminants from this Site. Such release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

The selected remedy for the Five Points PCE Plume site addresses groundwater contaminated with tetrachloroethene, also known as perchloroethylene (PCE). The remedy consists of extracting groundwater at the plume core and the plume toe to hydraulically contain the plume; treatment of the extracted groundwater, if necessary; to restore groundwater to beneficial use and institutional controls (ICs) to prevent exposure to PCE contaminated groundwater. The major components of the selected remedy include:

- The installation of a system at the plume core and plume toe to extract PCE contaminated groundwater. The system will consist of multiple extraction and performance monitoring groundwater wells.

- Hydraulic containment of the PCE contaminated groundwater by extracting groundwater at an estimated rate of 200 gallons/minute (gpm) at the plume core and 300 gpm at the plume toe or other appropriate rates.

- Treatment of extracted groundwater with granular activated carbon (GAC), if necessary, and discharge to an offsite Publically Owned Treatment Works (POTW).

- ICs discouraging the drilling and installation of new groundwater wells until remedial action objectives and clean-up goals are achieved.

Statutory Determinations

The selected remedy for the Five Points PCE Plume Site is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate for the remedial action, is cost effective, and utilizes permanent solutions and alternative technologies to the extent practicable. The selected remedy also satisfies the statutory preference for treatment as a principal element of the remedy. The remedy reduces the toxicity, mobility and volume of hazardous substances, pollutants or contaminants through extraction and treatment of contaminated groundwater.

Because the remedy will take up to 20 years to achieve cleanup goals, the Site will be subject to five-year reviews. A statutory review will be conducted no less than every five years after initiation of the remedial action to ensure that the remedy is, or will be protective of human health and the environment.

ROD Data Certification Checklist

The following information is included in the Decision Summary section of the ROD. Additional information can be found in the Administrative Record file for this site.

- Current and potential future land and groundwater use that will be available at the Site as a result of the selected remedy (Section 6.0)
- Baseline risk represented by the Chemicals of Concern (COCs) (Section 7.0)
- COCs and their respective concentrations (Section 7.1.2 and Tables 3 and 4)
- Remedial action objectives (RAOs) and cleanup goals established for the COC and the basis for the goals (Section 8.0)
- Whether source materials constituting principal threats are found at the Site (Section 11.0)
- Key factors that led to selecting the remedy (Section 12.1)
- Estimated capital, operation and maintenance (O&M) and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 12.3 and Tables 11 and 12)
- Potential land and groundwater use that will be available at the Site as a result of the selected remedy (Section 12.4)

Authorizing Signatures

This ROD documents the selected remedial action to address the contamination at the Five Points PCE Plume NPL site.

The following authorized official at EPA Region 8 approves the selected remedy as described in this ROD.

8/12/16
Martin Hestmark
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation
U.S. Environmental Protection Agency, Region 8
Date

The following authorized official at the State of Utah concurs with the selected remedy for the Five Points PCE Plume NPL site as described in this ROD.

8/28/16
Alan Matheson
Executive Director
Utah Department of Environmental Quality
Date

FIGURES

TABLES

APPENDICES

ACRONYMS

°F	Degrees Fahrenheit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ADI	Average Daily Intake
ARARs	Applicable or Relevant and Appropriate Requirements
AOC	Administrative Order on Consent
bgs	Below Ground Surface
BHHRA	Baseline Human Health Risk Assessment
COCs	Chemicals of Concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
COCs	Chemicals of Concern
CR	Cancer Risk
DERR	Division of Environmental Response and Remediation
EPA	Environmental Protection Agency
FS	Feasibility Study
GAC	Granular Activated Carbon
gpm	Gallons/Minute
HI	Hazard Index
HQ	Hazard Quotient
ICs	Institutional Controls
ISCO	In-situ Chemical Oxidation
IRIS	Integrated Risk Information System
LADI	Lifetime Average Daily Intake
MEP	Maximum Extent Practicable
MCL	Maximum Contaminant Level
NAPLs	Non-Aqueous Phase Liquids
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
PCE	Tetrachloroethene or Perchloroethylene
POTW	Publically Owned Treatment Works
RD	Remedial Design
RAOs	Remedial Action Objectives
RfD	Reference Dose
RI	Remedial Investigation
ROD	Record of Decision
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act of 1986
SF	Slope Factor
TBC	To Be Considered
TCE	Trichloroethene
UAC	Utah Administrative Code
UDEQ	Utah Department of Environmental Quality
USC	U.S. Code
VOCs	Volatile Organic Compounds
YVC	Your Valet Cleaners

Five Points PCE Plume Superfund Site
Bountiful, Utah

Decision Summary

DECISION SUMMARY

1.0 SITE NAME LOCATION AND DESCRIPTION

The Five Points PCE Plume site (Site) is located on the boundary between Bountiful City and Woods Cross City, Davis County, Utah. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number is UT0008921894. The lead agency for the Five Points PCE Plume Site is the UDEQ, Division of Environmental Response and Remediation (DERR) and the U.S. EPA Region 8 is the support agency. Superfund Trust funds will be used to implement the selected remedy.

The Site was previously known as the Bountiful Five Points PCE Plume Site and was renamed to reflect the extent and impact of contaminated groundwater on municipal drinking water wells in Woods Cross City. The Site is located in a residential and commercial area near the vicinity of 1500 South and State Highway 106 (Figure 1). Groundwater beneath the Site contains elevated levels of chlorinated solvents, primarily tetrachloroethene (PCE) which has impacted municipal drinking water wells used by Woods Cross City and the City of North Salt Lake. The likely source for the groundwater contamination is Your Valet Cleaners (YVC) dry-cleaning facility in Bountiful, Utah.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

The YVC property consists of a small retail building and asphalt parking area located near the intersection of 200 West, Main Street, and 1500 South (Figure 1). PCE was used at YVC for the dry cleaning of fabrics from 1964 to 2002 before being replaced by a liquid silicone-based dry-cleaning solution. Investigations completed by the agencies at YVC suggest PCE may have been introduced to subsurface soils and groundwater by a leaking sewer pipe.

2.2 UDEQ and EPA Investigations

PCE was detected above the maximum contaminant level (MCL) of 5 µg/L in a Woods Cross City municipal drinking water well in 1996. Following this observation, several investigations were completed in order to determine the extent and source of the contamination.

An assessment was completed by UDEQ in 1998-1999 and included the installation/sampling of two monitoring wells and sampling of two Woods Cross City municipal drinking water wells. This assessment found PCE levels in groundwater as high as 310 µg/L and established YVC as the likely source for PCE contamination.

Two removal assessments were completed by EPA in November 1999 and July 2003. Activities associated with these removal assessments included the collection of groundwater and soil samples. These removal assessments confirmed the presence of PCE contamination in two Woods Cross City municipal drinking water wells and nearby monitoring wells. Soil samples collected during the July 2003 assessment found PCE contamination in subsurface soils at the YVC property.

In April 2001 UDEQ completed an Abbreviated Preliminary Assessment Report. This Report consolidated and summarized information from previous investigations and determined that further assessment was needed under CERCLA.

In October and November 2004 UDEQ conducted a Site Inspection which included the installation/sampling of two downgradient monitoring wells and provided information to support the sites placement on the NPL. This investigation confirmed the presence of PCE concentrations greater than the MCL in a Woods Cross City municipal drinking water well and nearby monitoring wells.

On December 27, 2006, YVC entered into an Administrative Order on Consent (AOC) with EPA to investigate and remove possible PCE source areas. The Removal Action resulting from the AOC was performed during May and June of 2007. The Removal Action included completion of a ground penetrating radar survey, sample collection, excavation and disposal of contaminated soil with PCE levels greater than 3,000 μg/kg and the removal of an underground storage tank.

The Five Points PCE Plume Site was proposed for listing on the National Priorities List (NPL) in March 2007 and was placed on the final NPL on September 19, 2007.

UDEQ and EPA completed a Remedial Investigation (RI) and Feasibility Study (FS) on March 28, 2014 and March 26, 2015, respectively. A total of 17 monitoring wells were installed and four soil borings were completed during the RI. The RI identified the vertical and horizontal extent of PCE contamination in groundwater and found that PCE concentrations exceeded the MCL of 5 μg/L. The FS identified and evaluated five remedial alternatives that would address PCE contamination in groundwater.

3.0 COMMUNITY PARTICIPATION

The Proposed Plan for the Site was made available to the public in July 2015. The Proposed Plan, RI Report and FS Report can be found in the Administrative Record file and information repository at the Davis County Library, South Branch; Utah Department of Environmental Quality, Division of Environmental Response and Remediation; and EPA Region 8 Records Center. The notice of the availability of the Proposed Plan was published in the Deseret News and Salt Lake Tribune on July 31, 2015 and in the Davis County Clipper on August 6, 2015. In addition to these newspapers a notice of the Proposed Plan availability and public meetings was placed in the Woods Cross City Community Newsletter and on the Woods Cross City and City of North Salt Lake web pages.

UDEQ and EPA accepted comments on the Proposed Plan from July 31, to August 31, 2015. Two public meetings were held on August 19, and 20, 2015 in Woods Cross City and North Salt Lake City, respectively to present the Proposed Plan to the citizens of each community. The public comment period was extended from August 31, 2015 to October 5, 2015 after receiving a request for a 30 day extension from Woods Cross City and the City of North Salt Lake on August 26, 2015. Responses to comments received during the public comment period are provided in the Responsiveness Summary (Appendix A) of this Record of Decision.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

This ROD identifies the selected remedy and addresses PCE contamination in groundwater. The remedy selected and documented in this ROD includes remedial action necessary to protect human health. Ingestion of water extracted from the aquifer poses a current and potential risk to human health because EPA's acceptable risk range is exceeded and concentrations of PCE are greater than the MCL for drinking water. The selected remedy is expected to restore groundwater to beneficial use as a drinking water source, prevent human exposure to contaminated groundwater and prevent future migration of the groundwater plume.

5.0 SUMMARY OF SITE CHARACTERISTICS

This section summarizes information obtained through the investigations and feasibility study. It includes a description of the Site conceptual model on which the investigations, risk assessment and response actions are based. The major characteristics of the Site and the nature and extent of contamination are summarized below. More detailed information is available in the Administrative Record for the Site.

5.1 Conceptual Model

The illustrated site conceptual model is provided as Figure 2. The exposure scenario evaluated in the Baseline Human Health Risk Assessment (BHHRA) was domestic use of groundwater by adult and children residents. Pathways included in the BHHRA were intentional ingestion of groundwater, dermal exposure to groundwater, and inhalation of volatile organic compounds (VOCs) in indoor air from household use of groundwater. The BHHRA determined that there is a potential for unacceptable risk as a result of PCE contamination in groundwater.

Impacts of VOCs in groundwater to indoor air via the vapor intrusion pathway were not evaluated in the BHHRA since VOC concentrations in groundwater are relatively low (less than 50 µg/L) and depths to PCE contaminated groundwater range from approximately 109 feet to 330 feet below ground surface (bgs). Based on these findings and in accordance with EPA 2002 *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* VOC concentrations would not be expected to impact indoor air.

5.2 Characteristics of the Site

The Site is located at the eastern edge of the Basin and Range physiographic province and is located west of the Wasatch Mountain Range and east of the Great Salt Lake. The site is in a residential and commercial area located in Woods Cross City and Bountiful City, Davis County, Utah. The site slopes from east to west at a gradient of approximately 0.02 feet per foot.

Climate at the Five Points PCE Plume Site is temperate and semiarid with a typical frost-free season from May to mid-October. The average annual precipitation is 23.37 inches. The annual evapotranspiration is 41.30 inches resulting in an average annual loss of 17.93 inches to evaporation. The average annual temperature is 51.8 degrees Fahrenheit (°F) with fluctuations ranging from over 100° F in summer months to below 0° F in winter months.

5.2.1 Regional Geology and Hydrogeology

Groundwater underlying the Site is within the Bountiful sub area of the East Shore Aquifer. The East Shore Aquifer lies within an elongate graben bounded by normal faulting along the Wasatch Fault zone to the east and undefined fault zone near the shore of the Great Salt Lake. Unconsolidated and semi-consolidated basin fill materials make up the majority of the subsurface. Basin fill material is composed of coarse grained alluvial and delta deposits near the Wasatch Mountains and interbedded gravels, sands, and clays with fine-grained lacustrine deposits near the Great Salt Lake.

The East Shore Aquifer system is primarily confined, with some unconfined areas along the mountain front. The Bountiful sub area of the East Shore Aquifer is described as having shallow, intermediate, and deep aquifers. The shallow aquifer has been described as being 60 to 250 feet bgs, the intermediate aquifer is considered to be 250 to 500 feet bgs and the deep aquifer is greater than 500 bgs. The shallow, intermediate, and deep aquifers are hydraulically connected with one another and the primary recharge area is located to the east, near the mountain front. Groundwater flow direction in the Bountiful sub area is typically towards the west/northwest and Great Salt Lake.

5.2.2 Site Geology and Hydrogeology

Near surface soils in the area of YVC (source area) consists of sandy clays and/or silty clays extending to depths of between 15 and 19 feet bgs, underlain by sandy gravels and gravelly sands. The deeper soils within the vadose zone underling the Site are primarily composed of well-graded (poorly-sorted) alluvial sediments consisting of sandy and gravelly cobbles that are interbedded with occasional intervals of gravelly and cobbley clays and silts.

Groundwater flow at the Site appears to be heavily influenced by the pumping of municipal drinking water wells. Groundwater measurements obtained during the RI indicate groundwater flow direction at the Site is to the west/southwest (Figure 3), which differs from the regional west/northwest flow direction. Vertical flow direction was determined to be downward for all nested well pairs installed during the RI.

Depth to groundwater at the Site ranges from approximately 140 feet bgs at monitoring well MW-101 in the eastern portion of the site to approximately 20 feet bgs at monitoring well MW-110i/d in the western portion of the site (Figure 3). Depth to groundwater decreases to the west beneath the site area, as the topography slopes toward the west.

5.2.3 Sampling Strategy

The sampling strategy completed during the RI focused on collecting samples from sub-surface soil, groundwater monitoring wells and municipal drinking water wells. The RI field activities began in July 2009 with the reconnaissance of existing monitoring wells for the purpose of confirming groundwater flow direction and continued until April 2013. RI field activities were performed in four separate phases (Figure 4) and included the installation of 17 monitoring wells, the completion of four soil borings and groundwater water monitoring and sampling. Post RI groundwater monitoring and sampling events were completed from January 2014 to February 2015.

Phase 1 RI activities were conducted from March to September, 2010 and evaluated source area soil contamination, groundwater flow direction, and initial groundwater contaminant concentrations. Four soil borings were installed on the YVC property to evaluate source area soils and three monitoring wells were installed to evaluate the horizontal and vertical extent of groundwater contamination. Information collected during Phase 1 was used to determine the location of monitoring wells installed as part of Phase 2.

Phase 2 RI activities were conducted from November 2010 to January 2011 and included the installation of four monitoring wells and subsequent groundwater monitoring and sampling. The purpose of Phase 2 was to identify the horizontal and vertical extent of PCE concentrations greater than the MCL of 5 µg/L. Information collected during this Phase indicated that PCE contamination in groundwater was deeper than originally thought. Based on this information it was determined that a third phase of well installation and groundwater monitoring and sampling was needed in order to understand the complex nature of groundwater conditions and further define the vertical extent of the PCE Plume.

Phase 3 RI activities were conducted from December 2011 to February 2012 and included the installation of four deeper monitoring wells near two of the wells completed during Phase 2 and the beginning of quarterly groundwater monitoring and sampling. PCE was detected in screening level samples collected from different depths during the drilling of the Phase 3 wells. These detections resulted in the installation of two 2 inch diameter nested wells screened at different depths in each borehole. Information obtained from the Phase 3 wells called in to question the impact of seasonal changes on the observed PCE concentrations and found that PCE exceeded the MCL of 5 µg/L. Based on this information, it was determined that a fourth phase of well installation was required and that quarterly groundwater monitoring and sampling for a period of one year was needed in order to evaluate any seasonal impacts to PCE concentrations.

Phase 4 RI activities were conducted in July and August 2012 and included the installation of six nested monitoring wells and quarterly groundwater monitoring and sampling. Monitoring wells completed as part of Phase 4 consisted of two 2-inch diameter nested wells screened at different depths in three separate boreholes. The purpose of Phase 4 was to define the vertical and horizontal extent of PCE contamination greater than the MCL of 5 µg/L in groundwater. Data obtained from the Phase 4 monitoring wells defined the horizontal and vertical extent of the PCE Plume.

The first and second quarters of groundwater monitoring and sampling were completed during Phases 3 and 4, respectively. The third and fourth quarter groundwater monitoring and sampling events were completed on November 28, 2012 and February 26, 2013, respectively. An additional sample was collected on April 8, 2013 from North Salt Lake City's Freda Well in order to confirm PCE concentrations detected in a sample collected from that well during the previous fourth quarter sampling and monitoring event.

A numerical groundwater flow and solute transport model was developed to support the evaluation of remedial alternatives in the FS. Assumptions for the groundwater flow model calibration and verification included (1) estimated and assumed pumping rates from the municipal drinking water wells, (2) assumed groundwater recharge rate, and (3) assumed hydraulic heads along the general head boundaries.

In conjunction with the FS and development of a groundwater model, an additional groundwater monitoring and sampling event was completed on January 28, 2014. In order to provide additional data for future design needs, quarterly groundwater monitoring and sampling was conducted from May 2014 to February 2015.

5.2.4 Impacted Media

Soil boring results from the RI concluded that PCE levels in soil at the YVC property would not represent a continued source to groundwater contamination. A total of 18 soil samples were collected from the YVC property (Figure 5) during the RI. Fifteen of these samples were collected from four soil borings and three samples were collected from an excavation that was dug to repair a sewer line that was damaged during the soil investigation. PCE concentrations in soil at the YVC property ranged from 0.46 µg/kg at DP-103 to 850 µg/kg at DP-102 (Table 1).

Groundwater sample results show that PCE concentrations in groundwater have exceed the MCL of 5 µg/L. The highest PCE concentration found during the RI in groundwater was 46 µg/L at MW-1-2004 (Table 2). PCE concentrations greater than the MCL define a plume area of approximately 189.8 acres that extends from monitoring well MW-1-2004 in the east to the Freda Well, a North Salt Lake City municipal drinking water well, in the west (Figure 6). The PCE plume is approximately 109 feet bgs in the eastern portion of the Site and descends downward to a depth of approximately 330 feet bgs in the western portion of the Site (Figure 7). The downward descent of the plume is likely due to current and historic pumping of municipal drinking water wells located near the western edge or toe of the groundwater PCE plume.

PCE contamination appears to span both the shallow and intermediate aquifers and has impacted drinking water wells operated by Woods Cross City and the City of North Salt Lake. Several other municipal drinking water wells threatened by PCE contamination are located downgradient of the PCE groundwater plume. Therefore, the likelihood for PCE contamination to be influenced by the operation of these wells and migrate towards them is high.

6.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

6.1 Land Uses

The YVC property currently consists of a small retail building that is used as a dry cleaning facility and asphalt parking area. Properties adjacent to YVC are commercial; however, residential properties are located in the surrounding area. It is anticipated that potential future land uses would be consistent with current residential and commercial uses, since the groundwater plume is located beneath mature and stable urban areas.

6.2 Groundwater Uses

Groundwater at the Five Points PCE Plume Site is used for municipal culinary purposes by Woods Cross City and the City of North Salt Lake; however, one well within the RI study area (i.e., Silver Eagle Well) is used for industrial purposes. Municipal drinking water wells operated by Woods Cross City and the City of North Salt Lake are located near the toe and downgradient of the PCE groundwater plume. PCE contamination in groundwater appears to span both the shallow and intermediate aquifers at the Five Points Site. The shallow and intermediate aquifers are defined by the State of Utah as a Class II drinking water source.

7.0 SUMMARY OF SITE RISKS

7.1 Summary of Human Health Risk Assessment

The BHHRA estimates what risks the Site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this Site.

7.1.2 Identification of Chemicals of Concern

Sampling results from the RI were evaluated and narrowed to six chemicals that would be considered COCs: PCE, trichloroethene (TCE), 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride. Three of the these six chemicals, 1,1-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride were never detected at the Site. The maximum detected concentration of cis-1,2-dichloroethene for all sampling locations and sampling events of 0.44 µg/L was well below the EPA Regional Screening Level (RSL) for tap water of 28 µg/L. Therefore, cis-1,2-dichloroethene was not evaluated further in the BHHRA.

As provided in Tables 3 and 4, PCE and TCE had maximum detected concentrations that exceeded their established tap water RSLs of 9.7 µg/L and 0.44 µg/L, respectively. Therefore, PCE and TCE were the COCs evaluated further in the BHHRA. The highest PCE and TCE concentrations found in groundwater during the RI were 46 µg/L and 0.61 µg/L, respectively.

The BHHRA found that PCE and TCE would not pose an unacceptable threat of non-cancer effects and TCE did not exceed EPA's cancer risk (CR) point of departure of 1×10^{-6}. Given the low concentrations of TCE in groundwater and the findings of the BHHRA, TCE is not considered a COC. PCE was found to be the risk driver for total CR since PCE exceeded EPA's CR point of departure. Therefore, PCE is the primary COC identified at the Five Points PCE Plume Site since it exceeded EPA's CR point of departure in the BHHRA and concentrations in groundwater have exceeded the MCL of 5 µg/L.

7.1.3 Exposure Assessment

The exposure scenario evaluated in the BHHRA was domestic use of groundwater by child and adult residents. Pathways included in the BHHRA were intentional ingestion of groundwater, dermal exposure to groundwater, and inhalation of VOCs in indoor air from household use of groundwater. Exposure factor values used in the BHHRA for domestic use of groundwater by child and adult residents is provided in Table 5. EPA default reasonable maximum exposure (RME) values for residents were used as exposure parameter values.

Impacts of VOCs in groundwater to indoor air via the vapor intrusion pathway was not evaluated in the BHHRA because concentrations of VOCs at the Site are relatively low and depths to contaminated groundwater range from approximately 109 feet to 330 feet bgs. VOCs at those concentrations and groundwater depths would not be expected to impact indoor air.

7.1.4 Toxicity Assessment

Toxicity values specific to the oral and inhalation pathways were obtained from EPA's RSL table. The original source for the oral and inhalation toxicity values was EPA's Integrated Risk Information System (IRIS). The EPA RSLs for PCE and TCE in tap water were calculated using these toxicity values. IRIS is considered to be the best source for toxicity values from the hierarchy of sources of toxicity values recommended by EPA.

There are no toxicity values specific to dermal exposure. Therefore, oral toxicity values were used in the BHHRA to assess risks from dermal exposure.

7.1.5 Risk Characterization

Potential for carcinogenic effects were characterized in terms of the incremental probability of an individual developing cancer over a lifetime as a result of site-related exposure to a potential carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Cancer Risk = LADI (mg/kg-day) x SF (risk per mg/kg-day)

where:

Cancer Risk = a unitless probability (e.g., 2×10^{-4}) of an individual's developing cancer
LADI = Lifetime Average Daily Intake
SF = Slope Factor

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime CR of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI>1 indicates that site-related exposures may present a risk to human health.

The HQ was calculated as follows:

Non-cancer HQ = ADI (mg/kg-day)/RfD (mg/kg-day)

where:

ADI = Average Daily Intake
RfD = Reference Dose

Two sampling locations were evaluated in the BHHRA by using concentrations from quarterly sampling events completed over the period of one year (Tables 6 and 7). Cancer risks and hazardous indices calculated for these locations are summarized in Table 8. The total CR calculated in the BHHRA exceeded EPA's point of departure of 1×10^{-6}. PCE was the risk driver for total CR since the CR from PCE alone exceeded 1×10^{-6}. The HIs calculated in the BHHRA were below EPAs acceptable level of one.

Assumptions used in the exposure assessment and toxicity assessment introduced uncertainty into the risk characterization results. While this could potentially lead to an underestimation of risk, the use of numerous conservative (i.e., protective of human health) assumptions probably resulted in a net overestimation of potential risk. Therefore, the results of the BHHRA are likely to be protective of health despite the inherent uncertainties in the process.

Additional information about the assumptions used in the exposure assessment and toxicity assessment can be found in the BHHRA for the Five Points PCE Plume Site (January 2014).

7.2 Ecological Risk Assessment

An ecological risk assessment was not conducted due to the absence of contaminant exposure pathways for ecological receptors. Contamination at the site exists in groundwater at depths greater than 100 feet below ground surface. There is no surface water in the vicinity of the site and groundwater does not daylight at any location. Therefore, an ecological risk assessment was not necessary to determine that contamination associated with the site does not pose an ecological risk.

7.3 Site Risk Conclusion

Contaminated groundwater at the Five Points PCE Plume Site poses a risk that is within the 10^{-4} to 10^{-6} risk range. Groundwater contamination did not exceed EPAs hazard index of one and would not pose an unacceptable threat of non-cancer effects to human health. An ecological risk assessment was not conducted due to the absence of exposure pathways for ecological receptors.

The aquifer beneath the Five Points PCE Plume Site is used as a drinking water source. Elevated levels of chlorinated solvents, primarily PCE, have impacted municipal drinking water wells that are owned and operated by Woods Cross City and the City of North Salt Lake. PCE concentrations in groundwater and municipal drinking water wells have exceeded the MCL of 5 μg/L. Therefore, remedial action at this Site is warranted and the response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants or contaminants from this Site. Such release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

8.0 REMEDIAL ACTION OBJECTIVES

RAOs for the Five Points PCE Plume Site were based on the results of the BHHRA and on Applicable or Relevant and Appropriate Requirements (ARARs). The RAOs developed for the Five Points PCE Plume Site are:

- Prevent human exposure to contaminated groundwater above acceptable levels;
- Prevent future migration of the contaminated groundwater plume; and
- Restore groundwater to beneficial use (drinking water standards) as a drinking water aquifer.

8.1 Cleanup Goals

Cleanup goals for the Five Points Site are derived mainly from the BHHRA and ARARs. The potential CR from exposure to contaminated groundwater exceeds EPAs point of departure of 1×10^{-6} for domestic use of groundwater by residents.

EPA's goal, under the NCP, is to reduce the excess cancer risk to the acceptable range of 1×10^{-4} to 1×10^{-6}. For residential exposures, 1×10^{-6} is the threshold risk factor for making risk management decisions, but risk managers may consider risk factors up to 1×10^{-4} before taking action. UDEQ and EPA have selected the MCL for PCE of 5 μg/L as the cleanup level for the Five Points PCE Plume Site. This cleanup level is based on the total CR which exceeded EPA's point of departure of 1×10^{-6} and use of groundwater as a public water supply by two municipalities

9.0 DESCRIPTION OF ALTERNATIVES

Several alternatives and technologies were considered to clean up groundwater at the Five Points PCE Plume Site. Appropriate alternatives and technologies were identified and screened for applicability to site conditions. Five alternatives were evaluated in the FS. For consistency and clarity, the alternatives summarized below are numbered to correspond with the alternative number provided in the FS.

9.1 Alternative 1 – No Action

Federal regulations require that a "no action" alternative be considered in order to provide a comparison between potential remedial alternatives. Under this alternative, no action would be taken to address the groundwater PCE plume. Groundwater contamination as shown in Figure 8 would remain in its current state and risks to human health would remain unchanged. Any reduction of groundwater contaminants would likely be due to natural migration, dispersion, attenuation, and degradation processes.

9.2 Alternative 2 – Extraction, Containment, and Treatment at Plume Toe

This alternative consists of hydraulic containment at the plume toe (Figure 9) and ICs. This alternative will prevent further migration of PCE contaminated groundwater and restrict drilling and installation of new groundwater wells.

Alternative 2 calls for the construction of a system to extract, hydraulically contain, and treat, if necessary, PCE contaminated groundwater at the plume toe. Construction of the system includes the installation of extraction and performance monitoring groundwater wells, pumps, piping and related facilities. This alternative takes into consideration the operation of nearby municipal drinking water wells and their impact on the groundwater PCE plume. Based on groundwater modeling, hydraulic containment will be accomplished by extracting groundwater at an estimated rate of 300 gpm or other appropriate extraction rate. Extracted groundwater will be treated with GAC, if necessary, and discharged to an offsite POTW.

Groundwater extraction at the plume toe will result in hydraulic containment at the plume toe and prevent contaminated groundwater from flowing to downgradient municipal drinking water wells. Effectiveness of the system will be monitored using water level measurements, monitoring well sampling, and system influent/effluent sampling.

ICs discouraging the drilling and installation of new groundwater wells along the projected path of the groundwater PCE plume until RAOs and clean-up goals are achieved will be established as part of this remedial alternative. UDEQ and EPA will work with the Utah Department of Water Rights and local jurisdictions to establish these ICs to advise applicants of risks and to discourage the drilling and installation of new groundwater wells.

Periodic reviews will be required to evaluate the effectiveness of this remedial alternative. These reviews will be performed no less often than every five years as long as hazardous substances, pollutants, or contaminants remain above levels that allow for unrestricted use and unlimited exposure.

9.3 Alternative 3 – Extraction, Containment, and Treatment at Plume Core

This alternative consists of extraction, containment, and treatment, if necessary, of PCE contaminated groundwater at the plume core (Figure 10) and ICs. The alternative will reduce contaminant volume, restore groundwater to beneficial use at the plume core and restrict drilling and installation of new groundwater wells. Groundwater extraction will also result in hydraulic containment of contaminated groundwater and prevent further migration of higher PCE concentrations found in the plume core.

Alternative 3 calls for the construction of a system to extract, hydraulically contain, and treat, if necessary, PCE contaminated groundwater at the plume core. Construction of the system includes the installation of extraction and performance monitoring groundwater wells, pumps, piping and related facilities. This alternative takes into consideration the operation of nearby municipal wells and their impact on the groundwater PCE plume.

Groundwater modeling, found hydraulic containment at the plumes core will be accomplished by extracting groundwater at an estimated rate of 200 gpm or other appropriate extraction rate. Extracted groundwater will be treated with GAC, if necessary and discharged to an offsite POTW. Containment at the plume core will not prevent further migration of PCE concentrations found at the plume toe. Effectiveness of the system will be monitored using water level measurements, monitoring well sampling, and system influent/effluent sampling.

ICs discouraging the drilling and installation of new groundwater wells along the projected path of the groundwater PCE plume until RAOs and clean-up goals are achieved will be established as part of this remedial alternative. UDEQ and EPA will work with the Utah Department of Water Rights and local jurisdictions to establish these ICs to advise applicants of risks and to discourage the drilling and installation of new groundwater wells.

Periodic reviews will be required to evaluate the effectiveness of this remedial alternative. These reviews will be performed no less often than every five years as long as hazardous substances, pollutants, or contaminants remain above levels that allow for unrestricted use and unlimited exposure.

9.4 Alternative 4 – Extraction, Containment, and Treatment at Plume Core and at Plume Toe

Alternative 4 is a combination of all of the components of Alternative 2 and Alternative 3 and consists of extraction, containment and treatment, if necessary, at the plume core; and at the plume toe (Figure 11); and ICs. This alternative will reduce contaminant volume, restore groundwater to beneficial use; and prevent further migration of PCE contaminated groundwater; and restrict drilling and installation of new groundwater wells.

Alternative 4 calls for the construction of a system to extract, hydraulically contain, and treat, if necessary, PCE contaminated groundwater at the plume core and at the plume toe. Construction of the system includes the installation of extraction and performance monitoring groundwater wells, pumps, piping and related facilities. This alternative takes into consideration the operation of nearby municipal wells and their impact on the groundwater PCE plume.

Groundwater modeling found hydraulic containment will be accomplished by extracting groundwater at an estimated rate of 200 gpm or other appropriate extraction rate at the plume core and at an estimated 300 gpm or other appropriate extraction rate at the plume toe. Extracted groundwater will be treated with GAC, if necessary and discharged to an offsite POTW.

Operation of the system at the plume core and plume toe will prevent the migration of PCE contaminated groundwater to downgradient municipal drinking water wells and reduces the risk of direct contact or ingestion of PCE contaminated groundwater through domestic use. Effectiveness of the system will be monitored using water level measurements, monitoring well sampling and system influent/effluent sampling.

ICs discouraging the drilling and installation of new groundwater wells along the projected path of the groundwater PCE plume until RAOs and clean-up goals are achieved will be established as part of this remedial alternative. UDEQ and EPA will work with the Utah Department of Water Rights and local jurisdictions to establish these ICs to advise applicants of risks and to discourage the drilling and installation of new groundwater wells.

Periodic reviews will be required to evaluate the effectiveness of this remedial alternative. These reviews will be performed no less often than every five years as long as hazardous substances, pollutants, or contaminants remain above levels that allow for unrestricted use and unlimited exposure.

9.5 Alternative 5 –Extraction, Containment, and Treatment at Plume Toe and ISCO at Plume Core

This alternative includes all of the components of Alternative 2; in-situ chemical oxidation (ISCO) treatment at the plume core; (Figure 12) and ICs. This alternative will prevent further migration of PCE contaminated groundwater at the plume toe; and reduce contaminant volume at the plume core and restore groundwater to beneficial use; and restrict drilling and installation of new groundwater wells.

Alternative 5 calls for the construction of a system to extract and hydraulically contain PCE contaminated groundwater at the plume toe and inject potassium permanganate into PCE contaminated groundwater at the plume core. Implementation of this alternative includes the installation of extraction, injection, and performance monitoring groundwater wells; pumps; piping; and related facilities; and injection of potassium permanganate every three years. This alternative takes into consideration the operation of nearby municipal wells and their impact on the groundwater PCE plume.

Groundwater modeling found hydraulic containment at the plume toe will be accomplished by extracting groundwater at an estimated rate of 300 gpm or other appropriate extraction rate. Extracted groundwater will be treated with GAC, if necessary, and discharged to an offsite POTW. ISCO treatment at the plume core will consist of injecting an estimated 286,000 pounds of potassium permanganate with approximately 1.7 million gallons of water.

Operation of the extraction system will result in hydraulic containment at the plume toe, prevent contaminated groundwater from flowing to downgradient municipal drinking water wells and reduces the risk of direct contact or ingestion of contaminated groundwater through domestic use. ISCO treatment at the plume core will reduce contaminant volume and restore groundwater to beneficial use by breaking down PCE into less toxic compounds.

Effectiveness of hydraulic containment at the plume toe will be monitored using water level measurements, monitoring well sampling, and system influent/effluent sampling. The effectiveness of ISCO will be evaluated by VOC concentrations and groundwater geochemistry within and downgradient of the treatment area.

ICs discouraging the drilling and installation of new groundwater wells along the projected path of the groundwater PCE plume until RAOs and clean-up goals are achieved will be established as part of this remedial alternative. UDEQ and EPA will work with the Utah Department of Water Rights and local jurisdictions to establish these ICs to advise applicants of risks and to discourage the drilling and installation of new groundwater wells.

Periodic reviews will be required to evaluate the effectiveness of this remedial alternative. These reviews will be performed no less often than every five years as long as hazardous substances, pollutants, or contaminants remain above levels that allow for unrestricted use and unlimited exposure.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP requires that each remedial alternative be evaluated according to specific criteria. The purpose of this evaluation is to promote consistent identification of the relative advantages and disadvantages of each alternative, thereby guiding selection of remedies offering the most effective and efficient means of achieving cleanup goals. There are nine criteria by which feasible remedial alternatives are evaluated. While all nine criteria are important, they are weighted differently in the decision-making process depending on whether they describe or involve protection of human health and the environment or compliance with federal or state statutes and regulations (threshold criteria), a consideration of technical or socioeconomic merits (primary balancing criteria), or the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria).

A comparison between remedial alternatives for which a detailed analysis was performed in the FS is provided in Table 9.

10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

All of the alternatives except the "no action" alternative would provide adequate protection of human health and the environment. Alternatives 2, 4, and 5 provide protection of human health since hydraulic containment would prevent migration of contaminated groundwater to municipal drinking water wells. Alternatives 3, 4, and 5 will reduce contaminant volume, restore groundwater to beneficial use, and prevent further migration of higher PCE concentrations found in the plume core. ICs discouraging the drilling and installation of new groundwater wells until RAOs are achieved for each alternative will prevent unacceptable human exposure to the COC.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

It is expected that Alternatives 2, 3, 4, and 5 can meet all ARARs identified in Tables 13, 14, and 15. Although Alternative 1 (no action) is estimated to be able to meet chemical specific ARARSs in a reasonable time frame, it does not meet the threshold criteria for compliance with overall protection of human health and the environment and therefore is not analyzed in the other criteria below.

10.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

Alternatives 2, 3, 4, and 5 will mitigate risk while the systems are in operation, and once RAOs have been achieved there will be no unacceptable residual risk. Hydraulic containment will prevent contaminated groundwater from migrating to municipal drinking water wells. Alternative 3 does not immediately prevent groundwater from migrating to municipal drinking water wells since it addresses the plume core and not the plume toe. ICs will effectively discourage the drilling and installation of groundwater wells until RAOs are met. Alternatives 3, 4, and 5 include extraction and treatment at the plume core which will reduce the period of time needed to reach cleanup objectives. Based on groundwater modeling it is estimated that RAOs will be achieved in 20 years for Alternative 4; 25 years for Alternatives 3 and 5; and 30 years for Alternative 2.

10.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 2, 3, 4, and 5 reduce toxicity, mobility, or volume by extracting, treating, and containing contaminated groundwater. The extraction and treatment, if necessary, of contaminated groundwater in Alternatives 3, 4, and 5 would reduce the volume of groundwater contamination in the plume core and decrease the time frames for achieving RAOs. The volume of contaminated groundwater reduced by Alternative 2 would be minimal, since Alternative 2 extracts and treats, if necessary, groundwater with lower contaminant concentrations found in the plume toe.

10.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup goals are achieved.

Alternatives 2, 3, 4, and 5 would protect the community by preventing PCE contaminated groundwater from migrating to municipal drinking water wells and would pose no additional risk to the community during remediation. There would also be no closure of businesses to maintain protection of human health during implementation of Alternatives 2, 3, 4, and 5. Alternative 5 may result in significant disruption of residential neighborhoods during construction and injection of potassium permanganate.

Alternatives 2, 3, and 4 pose a low level of risk to workers during remediation and Alternative 5 poses a moderate level of risk to works that handle the potassium permanganate. For all alternatives the use of proper personal protective and safety equipment will mitigate the risks posed to workers. It is estimated that it will take 3 months to construct the remedy and establish ICs for Alternatives 2 and 3; 3 to 6 months for Alternative 4; and 9 to 12 months for Alternative 5.

10.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Construction, operation and maintenance of Alternatives 2, 3, 4, and 5 involve standard techniques. Equipment and specialists for Alternatives 2, 3, and 4 are readily available from various sources. Alternative 5 would require specialized injection contractors. Effectiveness of Alternatives 2, 3, 4, and 5 would be evaluated through water level measurements, groundwater sampling and influent/effluent sampling.

Alternatives 2, 3, 4, and 5 will require coordinating water rights, and discharge of extracted groundwater with local officials. The treatment technology (GAC) for extracted groundwater is readily available, if required. Alternative 5 would also require a moderate level of coordination with state, local, and federal agencies for the injection of potassium permanganate. Preliminary discussions with the Utah Department of Water Rights and local officials indicate that ICs at the Site are implementable and will be based on State regulatory actions and local ordinances. The coordination of water rights with local officials is feasible since Woods Cross City and City of North Salt Lake indicate a willingness to provide water rights for the extraction of groundwater in joint comments submitted on the Proposed Plan.

10.7 Cost

The estimated total present worth cost of Alternative 3 ($2,725,000) has the lowest cost, followed by Alternative 2 ($3,370,000), Alternative 4 ($4,086,000), and Alternative 5 ($9,097,000). A comparison summary of capital costs, O&M costs, and total present worth costs for each alternative is provided in Table 10.

10.8 State Acceptance

The State of Utah through the UDEQ has been the lead agency in the development of the RI/FS for the Five Points PCE Plume Site and concurs with the selection of Alternative 4 as the selected remedy.

10.9 Community Acceptance

This criterion evaluates which components of the alternatives presented in the Proposed Plan the local community supports, have reservations about or oppose. During the public meetings, citizens and city officials commented regarding the beneficial use of extracted groundwater and potential use of a municipal drinking water well as an extraction point at the toe of the plume. UDEQ and EPA received written comments from three citizens, Woods Cross City, the City of North Salt Lake, Weber Basin Conservancy District, and UDEQ Division of Drinking Water. The comments generally supported the preferred alternative from the proposed plan. Responses to comments received during the public comment period are provided in the Responsiveness Summary (Appendix A) of this ROD.

11.0 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Contaminated groundwater generally is not considered to be a source material although non-aqueous phase liquids (NAPLs) may be viewed as source material. The manner in which principal threat wastes are addressed generally will determine whether the statutory preference for treatment as a principal element of a remedy is satisfied.

The Site consists of a groundwater plume contaminated with PCE. There are no known NAPLs at the Site and the RI concluded that PCE levels in soil at the YVC property would not represent a continued source for groundwater contamination. Based on this information, there are no principal threat wastes at the Five Points PCE Plume Site.

12.0 SELECTED REMEDY

The selected remedy for addressing PCE contamination in groundwater is Alternative 4 Extraction, Containment, and Treatment at Plume Core and at Plume Toe. The selected remedy meets the requirements of the two mandatory threshold criteria: protection of human health and the environment and compliance with ARARs while containing the contaminated groundwater plume and restoring groundwater to beneficial use through extraction and treatment, if necessary, of the contaminated groundwater.

12.1 Summary of the Rationale for the Selected Remedy

The principal factors considered in choosing Alternative 4 as the selected remedy are: 1) reduces contaminant volume; 2) provides hydraulic containment at both the plume core and plume toe; 3) prevents further migration of PCE contaminated groundwater; 4) meets RAOs sooner than the other alternatives that were considered; and 5) uses relatively simple and effective technology and treatment components. Costs associated with the selected remedy are comparable or less than other alternatives that were considered.

12.2 Description of the Selected Remedy

The selected remedy consists of extraction; hydraulic containment; treatment, if necessary, at the plume core; and at the plume toe (Figure 11); and ICs. The selected remedy calls for the construction of a system to extract, hydraulically contain, and treat, if necessary, PCE contaminated groundwater at the plume core and at the plume toe. Construction of the selected remedy includes the installation of extraction and performance monitoring groundwater wells, pumps, piping and related facilities.

The groundwater model developed for the Site indicates the selected remedy would meet cleanup goals and RAOs in approximately 20 years. Groundwater modeling also found hydraulic containment will be accomplished by extracting groundwater at an estimated rate of 200 gpm or other appropriate extraction rate at the plume core and at an estimated 300 gpm or other appropriate extraction rate at the plume toe. Extracted groundwater will be treated with GAC, if necessary, and discharged to an offsite POTW.

Capture zones shown in Figure 11 were based on the results of the groundwater model developed for the Site. It should be noted that the capture zone illustrated in Figure 11 does not contain the entire toe of the plume. However, the groundwater model shows that the selected remedy will maintain concentrations below the MCL at the municipal drinking water wells and prevent further migration of the groundwater PCE plume.

Operation of nearby municipal drinking water wells will likely have a large impact on the PCE groundwater plume. Pumping rates for nearby municipal drinking water wells are not well documented, and consistent. Changes to the municipal well pumping rates may alter the required pumping rates for extraction wells installed as part of the selected remedy. Operation of nearby municipal wells and the impact they have on extraction rates at the plume core and toe will need to be evaluated during the RD phase.

UDEQ and EPA will prepare an O&M Plan during the remedial action that will establish criteria for determining when RAOs and cleanup goals have been achieved. The remedy shall terminate once UDEQ and EPA have determined that RAOs and cleanup goals have been achieved.

ICs discouraging the drilling and installation of new groundwater wells along the projected path of the groundwater PCE plume until RAOs and clean-up goals are achieved will be established as part of this selected remedy. Preliminary discussions with Utah Department of Water Rights and local officials indicate that ICs at the Site are implementable.

12.3 Summary of the Estimated Remedy Costs

The cost estimate for the selected remedy is provided in Table 11 and the present worth analysis for the selected remedy is provided in Table 12. Cost estimate information is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. The cost estimate in Table 11 is an order-of magnitude engineering cost estimate that is expected to be within +50 to - 30 percent of the actual project cost.

12.4 Expected Outcomes of the Selected Remedy

The expected outcome of the selected remedy is the restoration of groundwater to beneficial use as a drinking water source after RAOs and cleanup goals have been achieved in an estimated 20 years. UDEQ and EPA have adopted the National Drinking Water Standard (40 CFR Part 141.61 and UAC R309-200-5) (MCL) of 5 µg/L for PCE as the groundwater cleanup level for the Site. In addition to the restoration of groundwater to beneficial use, the selected remedy is also expected to prevent human exposure to contaminated groundwater and prevent future migration of the groundwater plume.

13.0 STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective and provide permanent solutions to the extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated waste. The following sections discuss how the selected remedy meets the statutory requirements.

13.1 Protection of Human Health and the Environment

The selected remedy will protect human health and the environment through treatment, engineering controls, and/or ICs (NCP, 40 CFR §300.430(f)(5)(ii)). The remedy will prevent unacceptable risks from direct contact or ingestion of contaminated groundwater. Contaminated groundwater will be extracted, hydraulically contained, treated, if necessary; and monitored until PCE concentrations are at or below the MCL for PCE of 5 µg/L. Groundwater extraction, treatment, if necessary, and containment will reduce contaminant volume, restore groundwater to beneficial use, and prevent migration of contaminated groundwater to downgradient municipal drinking water wells. ICs will be implemented and maintained, to prevent any new domestic wells being constructed within the contaminated plume, until all RAOs and the cleanup goals have been achieved. The remedy is not expected to cause unacceptable short-term risks.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

Applicable or relevant and appropriate requirements are identified on a site-specific basis from information about site-specific chemicals, specific actions that are being considered, and specific features of the site location. There are three categories of ARARs: chemical-specific; action-specific; and location-specific.

Chemical-specific ARARs may determine cleanup levels for specific chemicals or discharge limits. Action-specific ARARs establish controls or restrictions on the remedial activities that are part of the remedial solution and are triggered by the specific remedial activity rather than the contaminants present. Location-specific ARARs set limitations on remedial activities as a result of the Site's location or physical characteristics. Where no ARARs exist for a given chemical, action or location, EPA may consider non-promulgated federal or State advisories and guidance as To Be Considered criteria (TBC). Although consideration of a TBC is not required, if standards are selected based on TBC, those standards are legally enforceable as performance standards.

The chemical specific, action specific, and location specific ARARs identified for the Five Points PCE Plume Site are provided in Tables 13, 14, and 15 respectively.

13.3 Cost Effectiveness

The selected remedy is determined to be cost effective. In making this determination the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (NCP, 40 C.F.R. §300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfy the threshold criteria. Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs, and, hence, this alternative represents a reasonable value for money to be spent.

The estimated present worth cost of the selected remedy is $4,086,000.

13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable (MEP)

UDEQ and EPA have determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the agencies have determined that the Selected Remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

13.5 Preference for Treatment as a Principal Element

The Selected Remedy satisfies the preference for treatment as a Principal Element. The remedy includes extraction and treatment, if necessary, of extracted contaminated groundwater. There are no known NAPLs at the Site and the RI concluded that PCE levels found in soil would not represent a continued source for groundwater contamination.

13.6 Five-Year Review Requirements

Because the Selected Remedy will take up to 20 years to achieve RAOs and cleanup goals, the Site will be subject to five-year reviews. As long as hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure, the remedy shall be reviewed no less than every five years after initiation of the remedial action to ensure that the remedy is, or will be protective of human health and the environment.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan was released for public comment in July 2015. It identified Alternative 4 as the preferred alternative, the same alternative chosen as the selected remedy.

There were no significant changes in the Selected Remedy.

The titles of Alternatives 2, 3, 4, and 5 were revised in this ROD. Alternative 2 was revised from "Containment at Plume Toe" to "Extraction, Containment, and Treatment at Plume Toe"; Alternative 3 was revised from "Containment at Plume Core" to "Extraction, Containment, and Treatment at Plume Core"; Alternative 4 was revised from "Containment at Plume Core and Plume Toe" to "Extraction, Containment, and Treatment at Plume Core and at Plume Toe" and Alternative 5 was revised from "Containment at Plume Toe and ISCO at Plume Core" to "Extraction, Containment, and Treatment at Plume Toe and ISCO at Plume Core". These revisions were made in order to accurately reflect the descriptions of Alternatives 2, 3, 4, and 5.

With the exception of changing the titles of Alternatives 2, 3, 4 and 5, the preferred alternative did not change between the Proposed Plan and ROD. However, UDEQ and EPA received proposals suggesting measures to increase efficiency and to reduce costs relative to two components of the preferred alternative. These two components involve the use of a municipal drinking water well as an extraction well at the toe of the plume and beneficial use of extracted groundwater. The proposals will be evaluated during design. Any proposed changes to the Selected Remedy resulting from the evaluation during design of these proposals will be supported and documented in the administrative record and an appropriate decision document.

FIGURES

Source Aerial Photograph : 2009 High Resolution Ortho-Imagery 1 Foot Color

Woods Cross City Municipal Well

Your Valet Cleaners Site (Suspected Source Area)

N W E S

0 250 500 750 1,000 Feet

Figure 1: Site Location Map

Five Points PCE Plume
Davis County, Utah

Utah Department of Environmental Quality
Division of Environmental Response and Remediation

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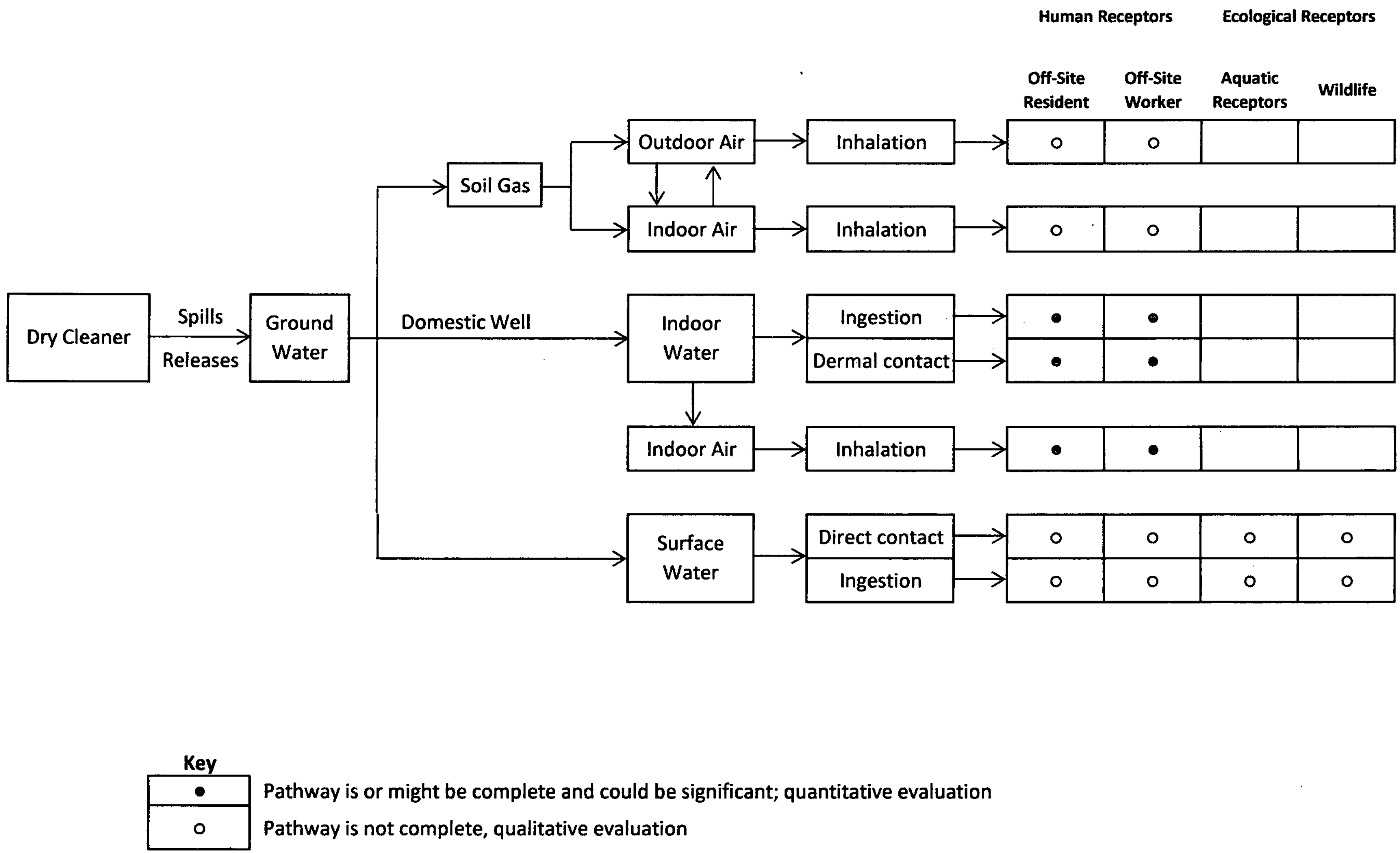
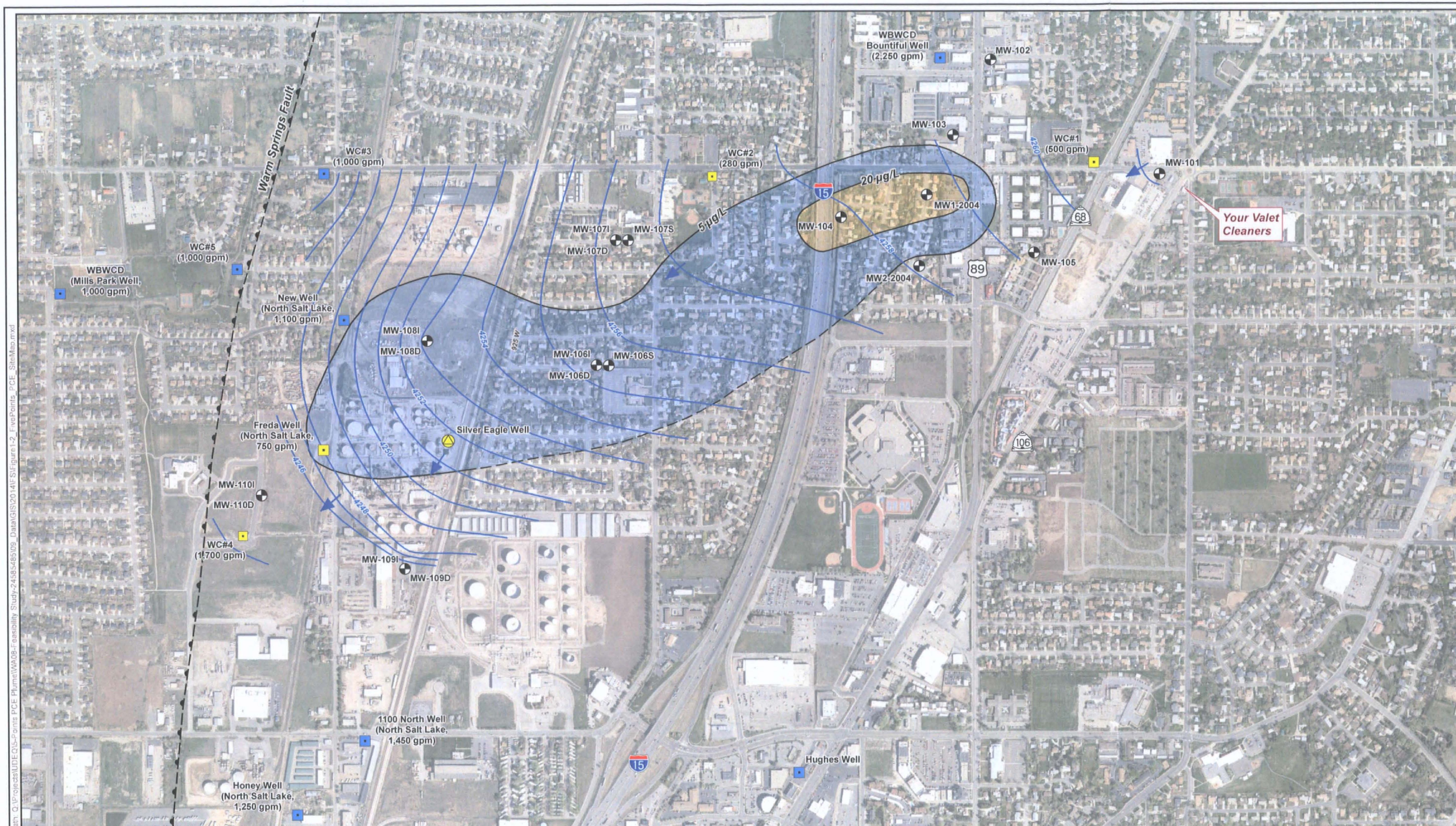
Figure 2: Illustrated Conceptual Site Model for Exposure to Groundwater





Source Aerial Photograph : ImageService://image.agrc.utah.gov/AerialPhotography_Color/HRO2012_Color6Inch_4Band

Monitoring Well

Drinking Water Well

Drinking Water Well No Longer in Use

Production Well

—4254— Groundwater Elevation Contour (feet above mean sea level) (February 26, 2013)

Groundwater Flow Direction (Approximate)

Approximate PCE Contour
Dashed where inferred

PCE Concentrations (February 2013)
Based on HydraSleeve Results

5 µg/L

20 µg/L

N

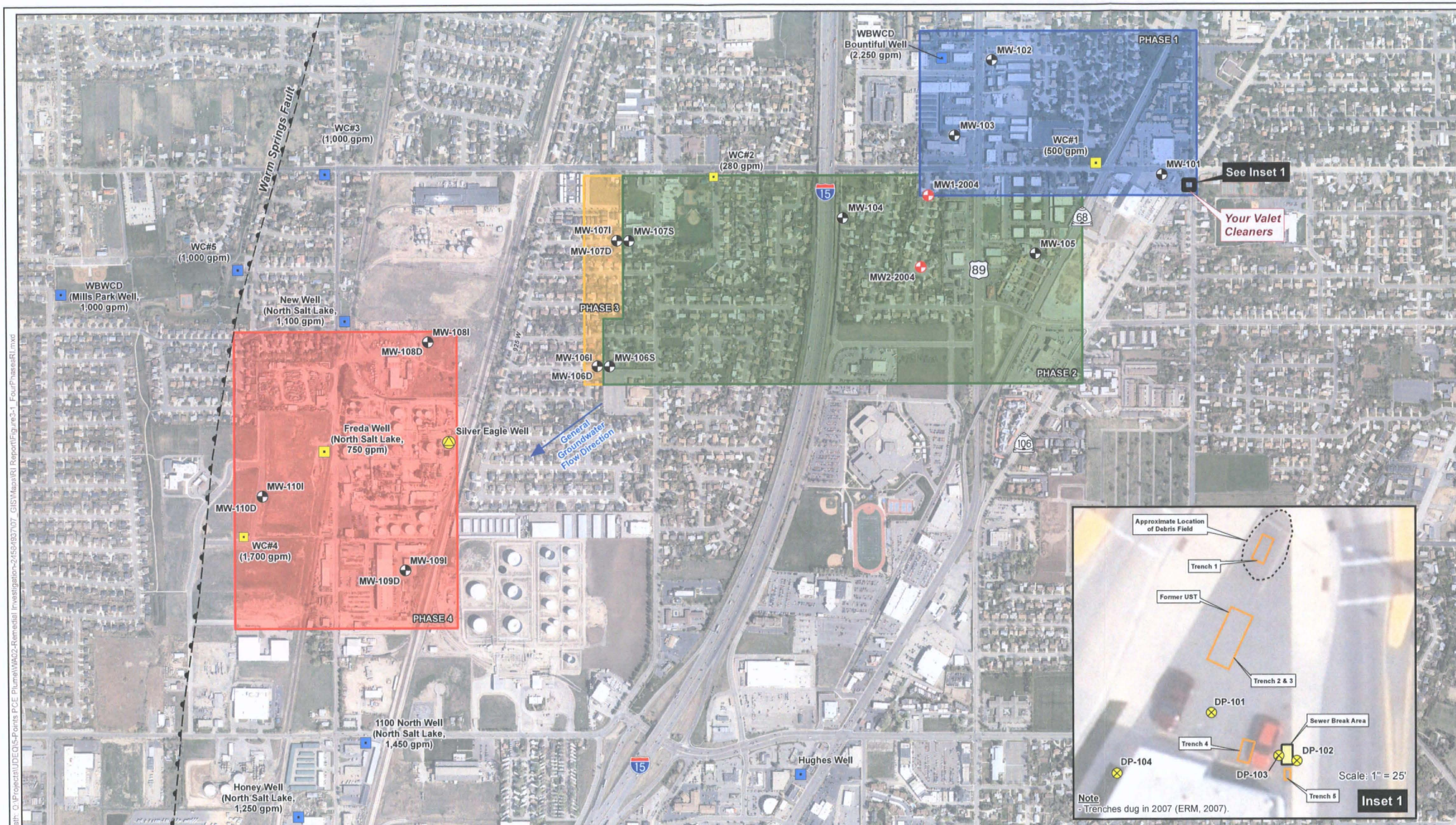
0 400 800 1,200 Feet
Scale 1:9,600 1 inch = 800 feet

Notes:
gpm - gallons per minute
µg/L - micrograms per liter
PCE - tetrachloroethene

Figure 3: Site Map Showing PCE Plume

Five Points PCE Plume
Davis County, Utah

Utah Department of Environmental Quality
Division of Environmental Response and Remediation



Source Aerial Photograph : ImageService://image.agrc.utah.gov/AerialPhotography_Color/HRO2012_Color6Inch_4Band

Path: O:\Projects\UDEQ\5-Points PCE Plume\WA02-Remedial Investigation-2458493707_GIS\Maps\RI Report\Figure3-1_FourPhasesRI.mxd

- Monitoring Well Installed During RI
- Pre-existing Monitoring Well
- Pre-existing Drinking Water Well
- Pre-existing Drinking Water Well No Longer in Use
- Pre-existing Production Well
- Geoprobe Sample Location - April 2010
- Historic Debris Field
- Historic Trench Locations
- 2010 Excavation Extent
- Phase 1
- Phase 2
- Phase 3
- Phase 4

Note:
• RI - Remedial Investigation

N

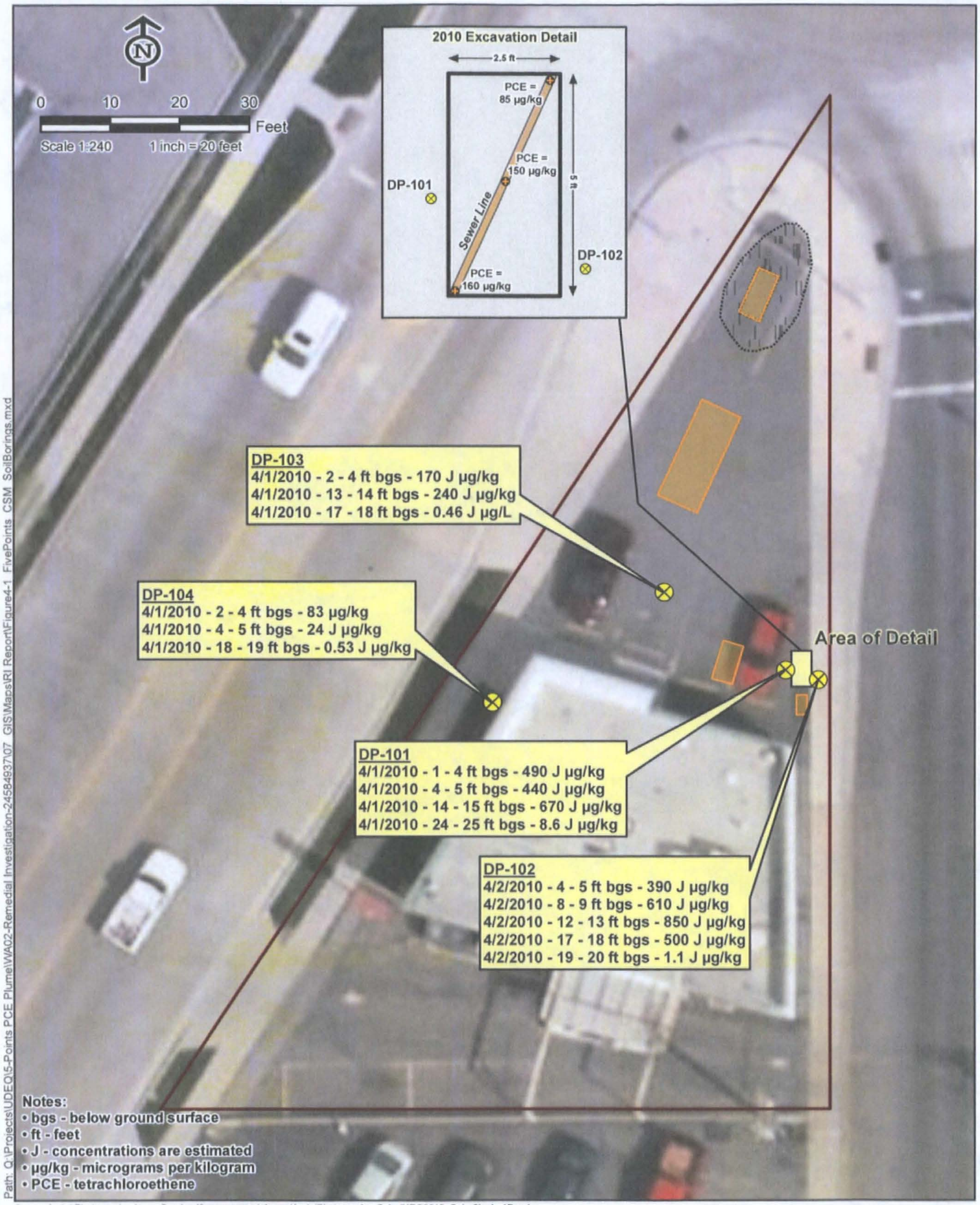
0 400 800 1,200 Feet

Scale 1:9,600 1 inch = 800 feet

Figure 4: Four Phases of RI Drilling and Sampling

Five Points PCE Plume
Davis County, Utah

Utah Department of
Environmental Quality
Division of Environmental
Response and Remediation



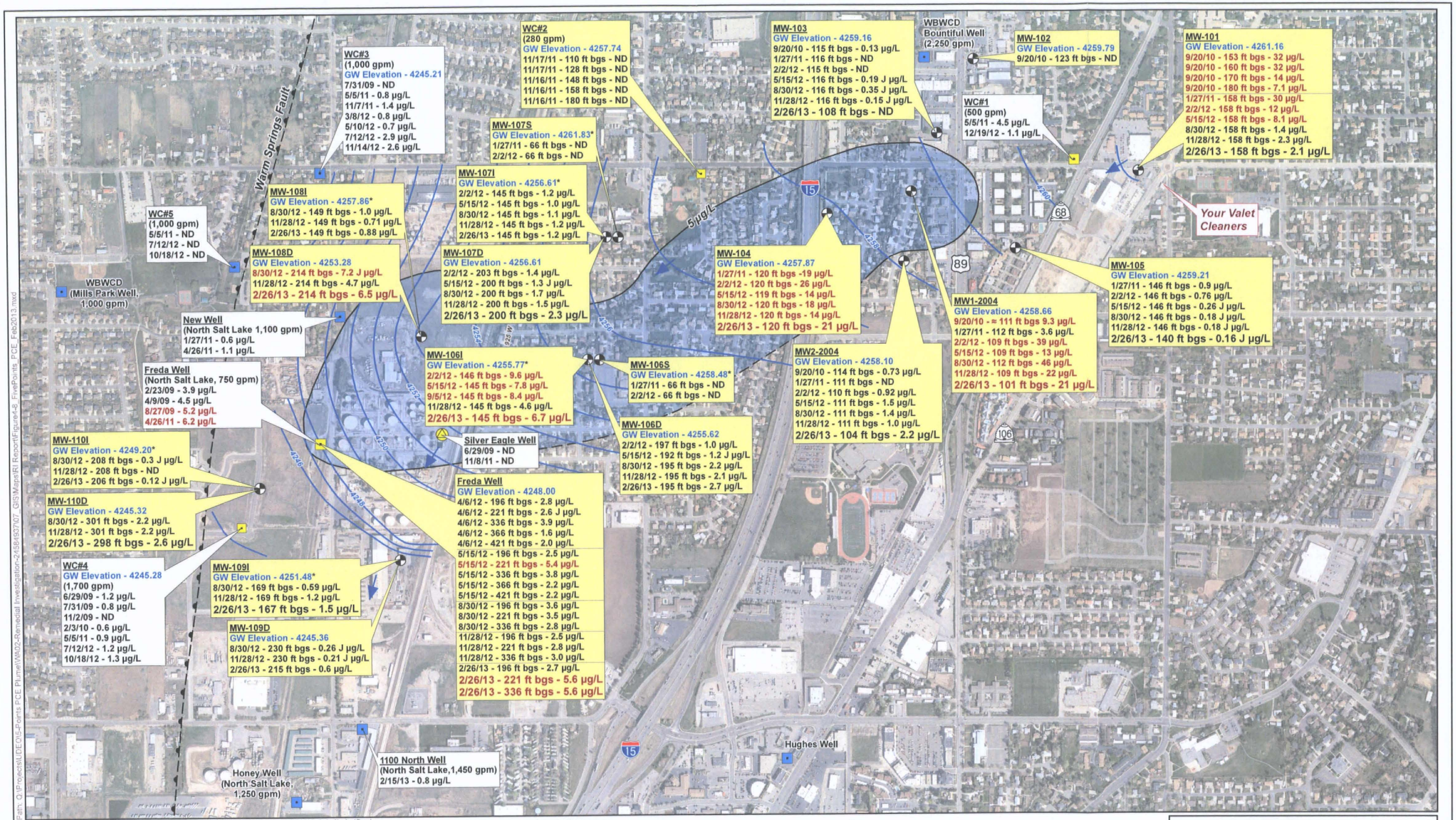
Source Aerial Photograph : ImageService://image.agrc.utah.gov/AerialPhotography_Color/HRO2012_Color6Inch_4Band

- Geoprobe Sample Location - April 2010
- 2010 Excavation Grab Sample Location
- Your Valet Cleaners Site
- Historic Debris Field
- Excavation Limits - April 1, 2010
- Historic Trench Locations

Figure 5: Soil Boring Locations and Soil PCE Data

Five Points PCE Plume
Davis County, Utah

Utah Department of Environmental Quality
Division of Environmental Response and Remediation



Source Aerial Photograph : ImageService://image.agrc.utah.gov/AerialPhotography_Color/HRO2012_Color6Inch_4Band

- Monitoring Well
- Drinking Water Well
- Drinking Water Well No Longer in Use
- Production Well
- –4254– Groundwater Elevation Contour (feet above mean sea level) (February 26, 2013)
- Groundwater Flow Direction (Approximate)

Approximate PCE Contour
Dashed where inferred

PCE Concentrations (µg/L)
Based on most recent results shown in larger font in text boxes

5 µg/L

N

0 400 800 1,200 Feet
Scale 1:9,600 1 inch = 800 feet

Notes:
- 4255.77* - asterisk indicates not used in potentiometric surface
- bgs - below ground surface
- ft - feet
- gpm - gallons per minute
- J - concentrations are estimated
- µg/L - micrograms per liter
- ND - Non-detect
- PCE - tetrachloroethene
- Red text indicates PCE concentration exceeds 5 µg/L.
- White result boxes indicate sample results received from the cities, which were sampled using the municipal well pumps.
- Yellow result boxes indicate hydrasleeve samples unless noted otherwise.

Figure 6: PCE Concentrations in Groundwater

Five Points PCE Plume
Davis County, Utah

Utah Department of Environmental Quality
Division of Environmental Response and Remediation

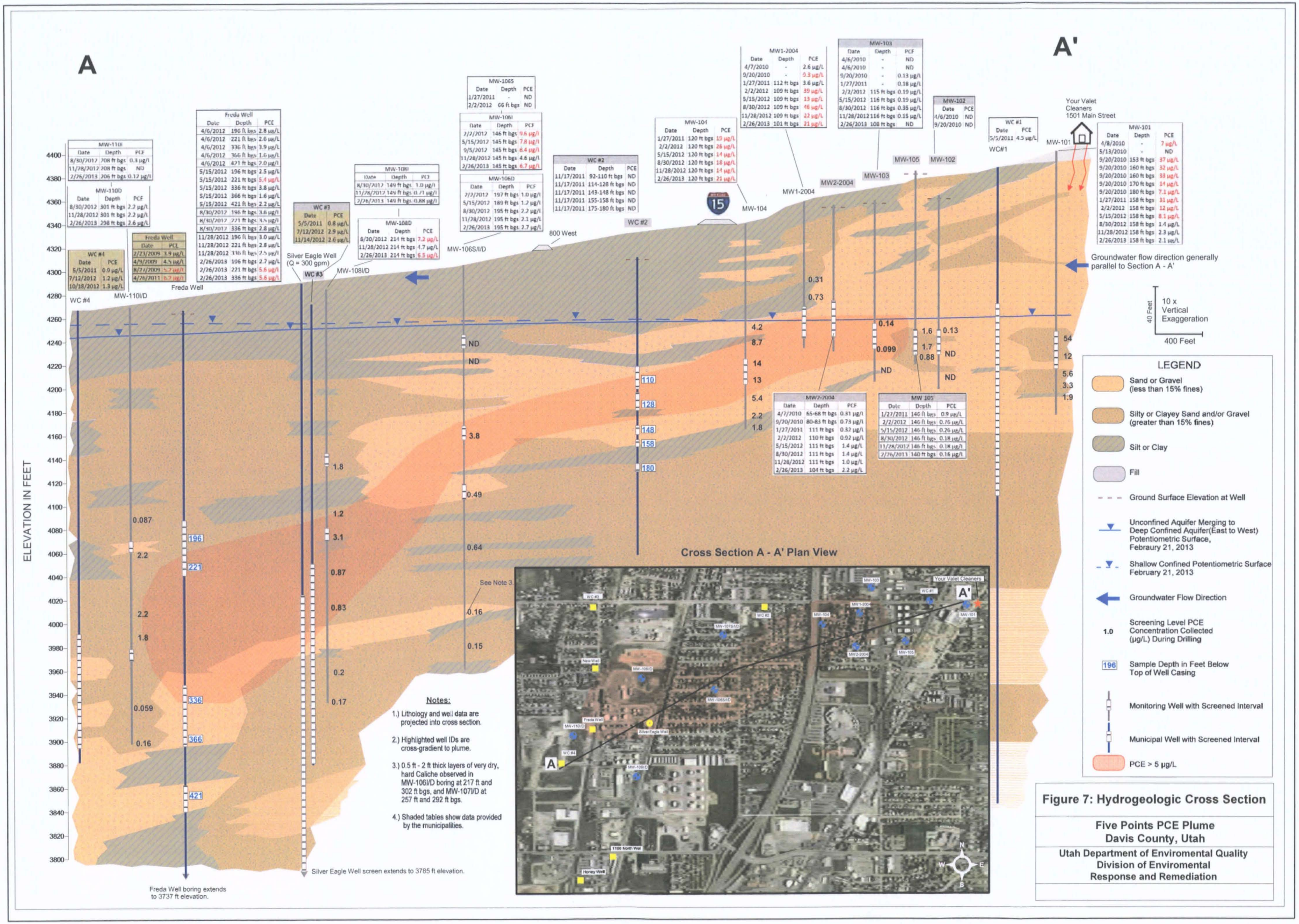
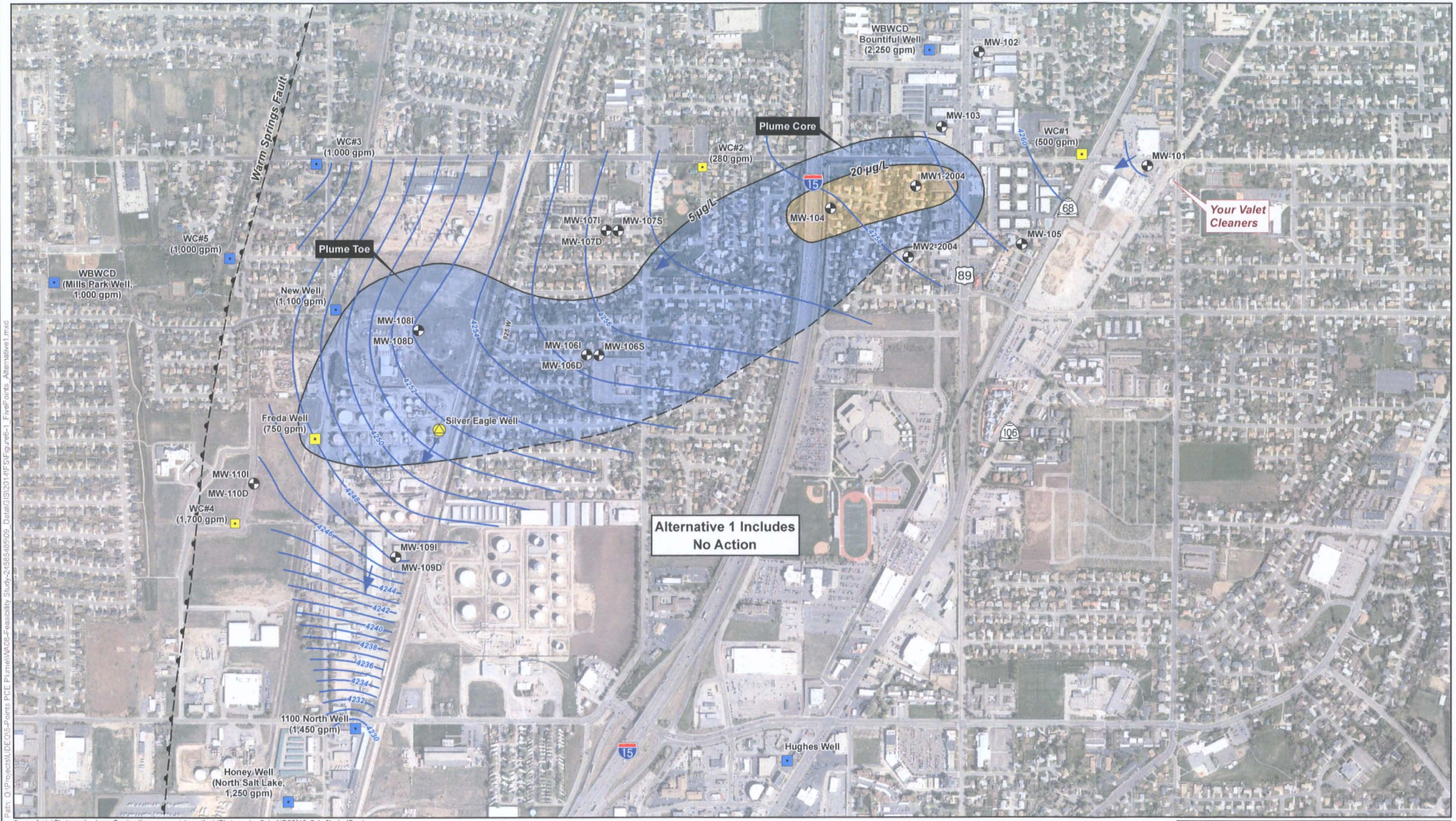


Figure 7: Hydrogeologic Cross Section

Five Points PCE Plume
Davis County, Utah

Utah Department of Enviromental Quality
Division of Enviromental
Response and Remediation



Monitoring Well

Drinking Water Well

Drinking Water Well No Longer in Use

Production Well not used for Groundwater Contouring

-4254- Groundwater Elevation Contour (feet above mean sea level) (February 26, 2013)

Groundwater Flow Direction (Approximate)

Approximate PCE Contour
Dashed where inferred

PCE Concentrations (February 2013)
Based on HydraSleeve Results

5 µg/L

20 µg/L

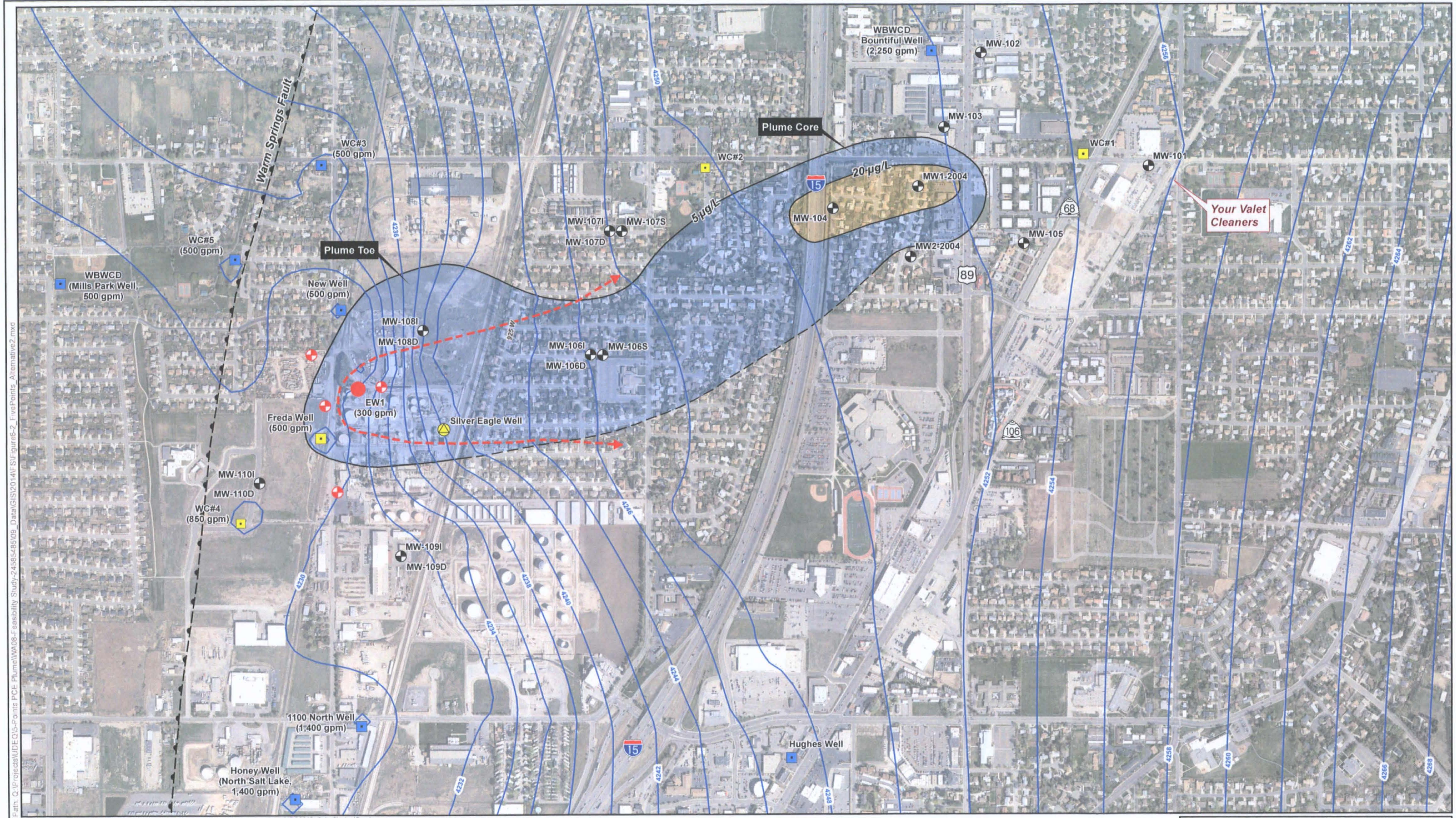
N

0 400 800 1,200 Feet
Scale 1:9,600 1 inch = 800 feet

Figure 8: Alternative 1 No Action

Five Points PCE Plume
Davis County, Utah

Utah Department of
Environmental Quality
Division of Environmental
Response and Remediation



Source Aerial Photograph : ImageService://image.agrc.utah.gov/AerialPhotography_Color/HRO2012_Color6Inch_4Band

- Monitoring Well
- Drinking Water Well
- Drinking Water Well No Longer in Use
- Production Well not used for Groundwater Contouring
- Proposed Extraction Well
- Proposed Monitoring Well

4254 **Modeled Groundwater Elevation Contour** (feet above mean sea level in Layer 3 of the Model, where the extraction well is proposed to be completed)

Approximate PCE Contour Dashed where inferred

Estimated Extraction Well Capture Zone

PCE Concentrations (February 2013)
Based on HydraSleeve Results
- *5 µg/L*
- *20 µg/L*

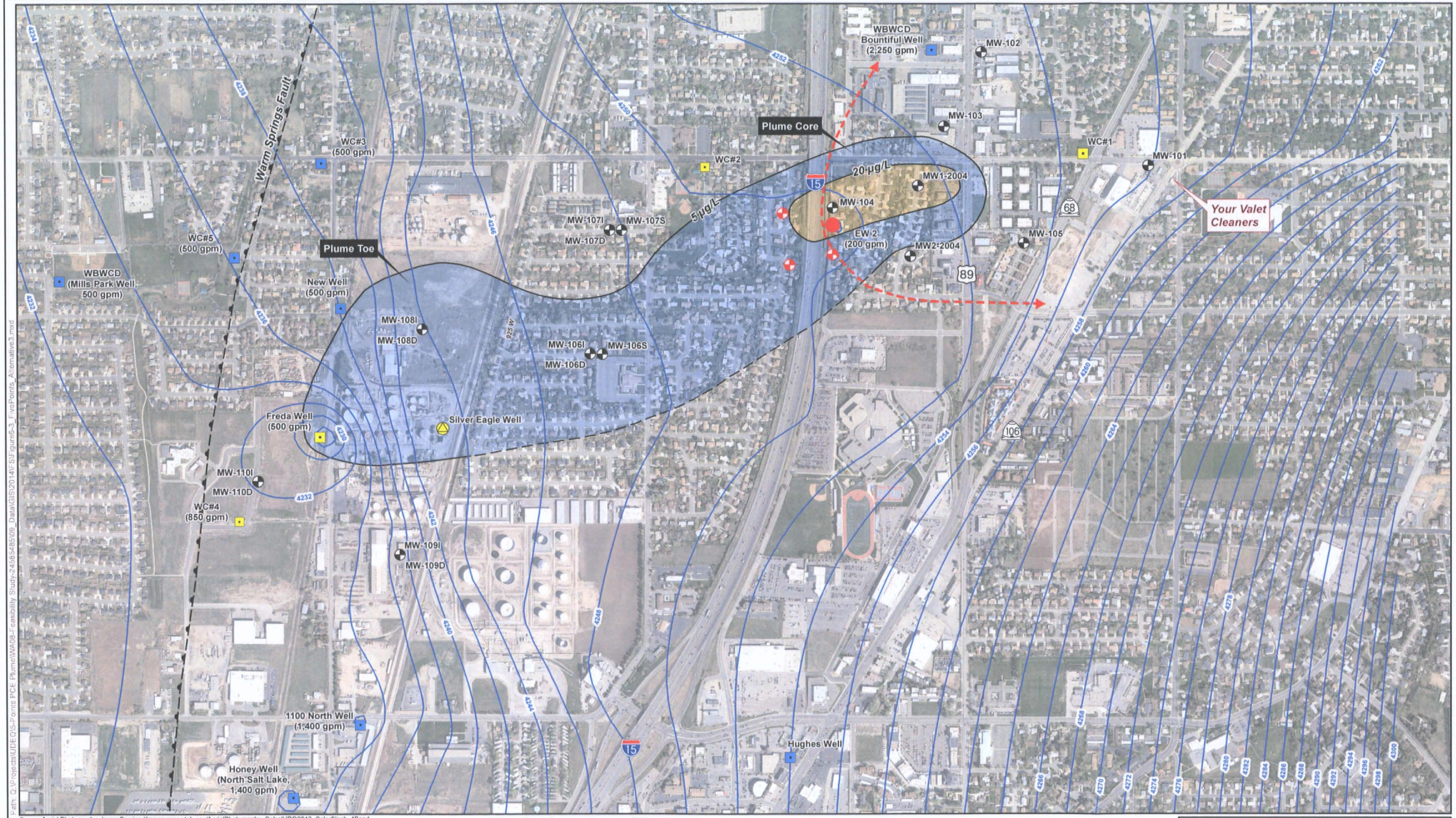
N

0 400 800 1,200 Feet
Scale 1:9,600 1 inch = 800 feet

Figure 9: Alternative 2 Extraction, Containment, and Treatment at Plume Toe

Five Points PCE Plume
Davis County, Utah

Utah Department of Environmental Quality
Division of Environmental Response and Remediation



Source Aerial Photograph : ImageService://image.agrc.utah.gov/AerialPhotography_Color/HRO2012_Color6Inch_4Band

Path: Q:\Projects\UDEQ\5-Points PCE Plume\WA08-Feasibility Study-24385485\09_Data\GIS\2014FS\Figure6-3_FivePoints_Alternative3.mxd

- Monitoring Well
- Drinking Water Well
- Drinking Water Well No Longer in Use
- Production Well not used for Groundwater Contouring
- Proposed Extraction Well
- Proposed Monitoring Well

4254 **Modeled Groundwater Elevation Contour**
(feet above mean sea level in Layer 2 of the Model, where the extraction well is proposed to be completed)

Approximate PCE Contour
Dashed where inferred

Estimated Extraction Well Capture Zone

PCE Concentrations (February 2013)
Based on HydraSleeve Results
- 5 µg/L
- 20 µg/L

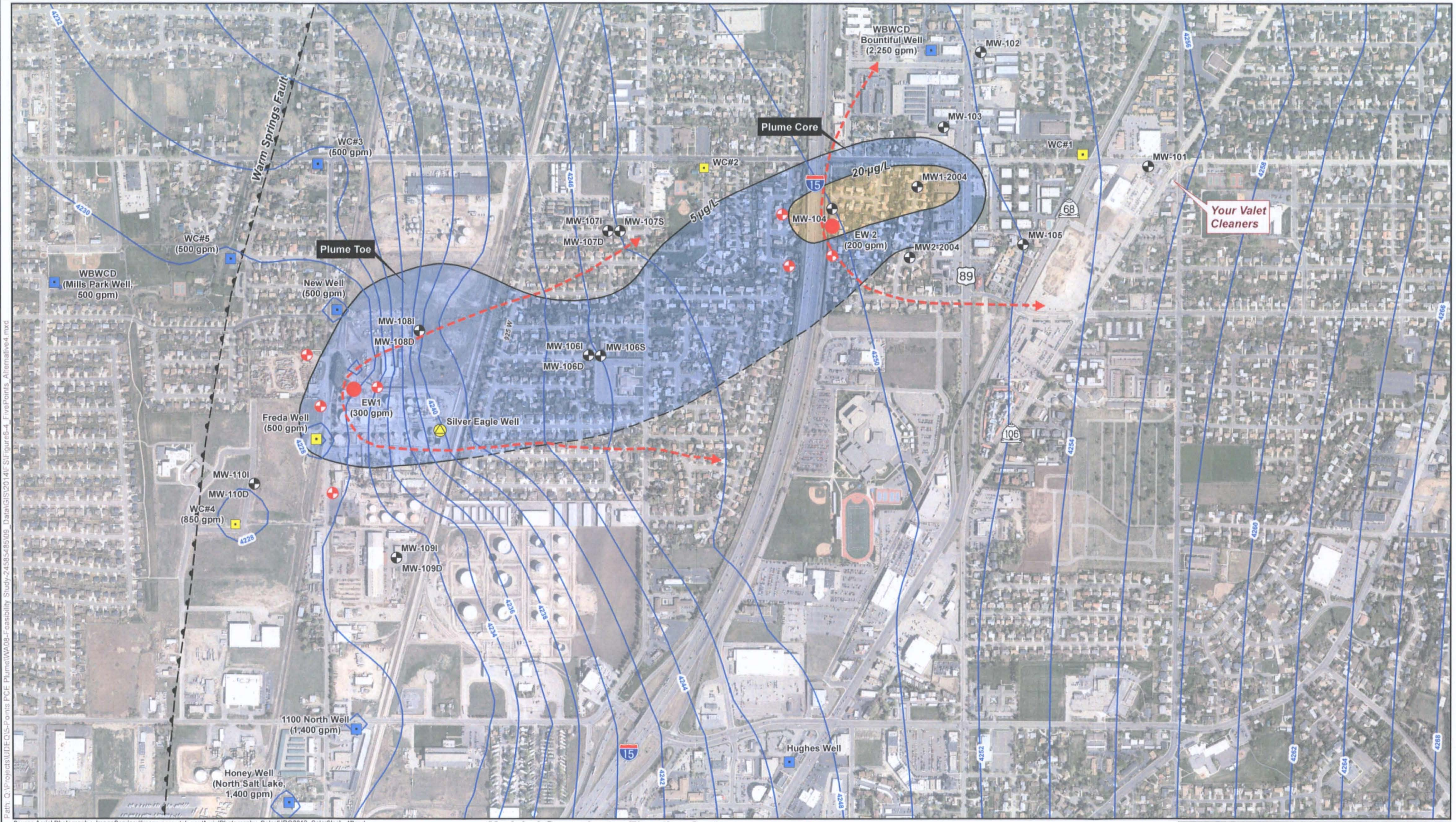
N

0 400 800 1,200 Feet
Scale 1:9,600 1 inch = 800 feet

Figure 10: Alternative 3 Extraction, Containment, and Treatment at Plume Core

Five Points PCE Plume
Davis County, Utah

Utah Department of
Environmental Quality
Division of Environmental
Response and Remediation



Source Aerial Photograph : ImageService://image.agrc.utah.gov/AerialPhotography_Color/HRO2012_Color6Inch_4Band

Monitoring Well

Drinking Water Well

Drinking Water Well No Longer in Use

Production Well not used for Groundwater Contouring

Proposed Extraction Well

Proposed Monitoring Well

—4254— **Modeled Groundwater Elevation Contour**
(feet above mean sea level in Layer 3 of the Model, where the extraction well at the toe of the plume is proposed. The contours in Layer 2, where the extraction well at the core of the plume is proposed to be completed, are not shown for simplicity's sake. Refer to Figure 6-3 for Layer 2 contours)

Approximate PCE Contour
Dashed where inferred

PCE Concentrations (February 2013)
Based on HydraSleeve Results

5 µg/L

20 µg/L

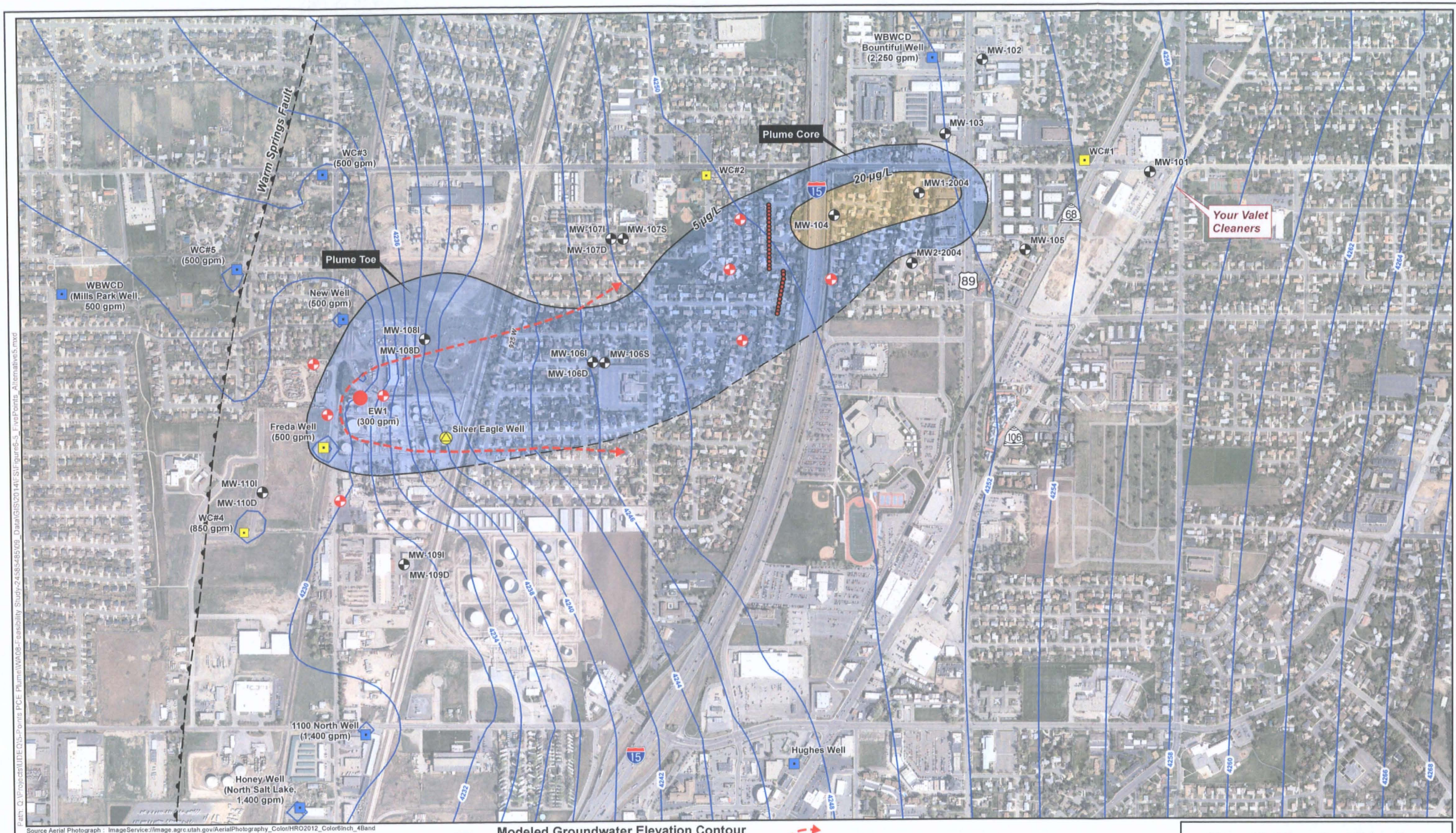
Estimated Extraction Well Capture Zone

0 400 800 1,200 Feet
Scale 1:9,600 1 inch = 800 feet

Figure 11: Alternative 4 Extraction, Containment, and Treatment at PlumeCore and at PlumeToe

Five Points PCE Plume
Davis County, Utah

Utah Department of Environmental Quality
Division of Environmental Response and Remediation



Monitoring Well

Drinking Water Well

Drinking Water Well No Longer in Use

Production Well not used for Groundwater Contouring

Proposed Extraction Well

Proposed Monitoring Well

4254 Modeled Groundwater Elevation Contour (feet above mean sea level in Layer 3 of the Model, where the extraction well is proposed to be completed)

Approximate PCE Contour
Dashed where inferred

ISCO Treatment Location

Estimated Extraction Well Capture Zone

PCE Concentrations (February 2013)
Based on HydraSleeve Results

5 µg/L

20 µg/L

0 400 800 1,200 Feet

Scale 1:9,600 1 inch = 800 feet

N

Figure 12: Alternative 5 Extraction, Containment, and Treatment at Plume Toe and ISCO at Plume Core

Five Points PCE Plume
Davis County, Utah

Utah Department of Environmental Quality
Division of Environmental Response and Remediation

TABLES

Table 1: Soil PCE Sample Results

Sampling Event	Location ID	Collection Date	Sample Depth (ft bgs)	Result (µg/kg)	Reporting Limit (µg/L)
Phase 1	DP-101	4/1/2010	1-4	490 J	7.3
Phase 1	DP-101	4/1/2010	4-5	440 J	5.3
Phase 1	DP-101	4/1/2010	14-15	670 J	10.4
Phase 1	DP-101	4/1/2010	24-25	8.6 J	5.9
Phase 1	DP-102	4/2/2010	4-5	390 J	333.8
Phase 1	DP-102	4/2/2010	8-9	610 J	334.5
Phase 1	DP-102	4/2/2010	12-13	850 J	464.4
Phase 1	DP-102	4/2/2010	17-18	500 J	397.4
Phase 1	DP-102	4/2/2010	19-20	1.1 J	4.8
Phase 1	DP-103	4/1/2010	2-4	170 J	5.7
Phase 1	DP-103	4/1/2010	13-14	240 J	5.7
Phase 1	DP-103	4/1/2010	17-18	0.46 J	5.4
Phase 1	DP-104	4/1/2010	2-4	83	6.7
Phase 1	DP-104	4/1/2010	4-5	24 J	5
Phase 1	DP-104	4/1/2010	18-19	0.53 J	7.7
Sewer Break	YVC-MID	4/1/2010	See Note 1	150	5.9
Sewer Break	YVC-SOUTH	4/1/2010	See Note 1	160	6
Sewer Break	YVC-NORTH	4/1/2010	See Note 1	85	5.9

Notes:
PCE - tetrachloroethene
ID - Identification
ft - feet
bgs - below ground surface
µg/kg - microgram per kilogram
J - associated value is estimated based on results of the data validation
Note 1: Sewer break samples were collected from the bottom of an approximately 5-foot deep excavation, collected from directly beneath the sewer pipe line.

Sampling Event	Location ID	Collection Date	Sample Depth (ft bgs)	Result (µg/L)	Reporting Limit (µg/L)
Phase 1	MW-101	9/20/2010	153	32	2.5
Phase 1	MW-101	9/20/2010	160	32	2
Phase 1	MW-101	9/20/2010	170	14	0.5
Phase 1	MW-101	9/20/2010	180	7.1	0.5
Phase 2	MW-101	1/27/2011	158	30	2
Phase 3	MW-101	2/2/2012	158	12	0.5
Phase 3	MW-101	5/15/2012	158	8.1	0.5
Phase 4	MW-101	8/30/2012	158	1.4	0.5
Phase 4	MW-101	11/28/2012	158	2.3	0.5
Phase 4	MW-101	2/26/2013	158	2.1	0.5
Phase 1	MW-102	9/20/2010	123	<0.5	0.5
Phase 1	MW-103	9/20/2010	115	0.13	0.5
Phase 2	MW-103	1/27/2011	116	<0.5 U	0.5
Phase 3	MW-103	2/2/2012	115	0.19 U	0.5
Phase 3	MW-103	5/15/2012	116	0.19 J	0.5
Phase 4	MW-103	8/30/2012	116	0.35 J	0.5
Phase 4	MW-103	11/28/2012	116	0.15 J	0.5
Phase 4	MW-103	2/26/2013	108	<0.5	0.5
Phase 2	MW-104	1/27/2011	120	19	0.5
Phase 3	MW-104	2/2/2012	120	26	2
Phase 3	MW-104	5/15/2012	119	14	0.5
Phase 4	MW-104	8/30/2012	120	18	0.5
Phase 4	MW-104	11/28/2012	120	14	0.5
Phase 4	MW-104	2/26/2013	120	21	2
Phase 2	MW-105	1/27/2011	146	0.9	0.5
Phase 3	MW-105	2/2/2012	146	0.76	0.5
Phase 3	MW-105	5/15/2012	146	0.26 J	0.5
Phase 4	MW-105	8/30/2012	146	0.18 J	0.5
Phase 4	MW-105	11/28/2012	146	0.18 J	0.5
Phase 4	MW-105	2/26/2013	140	0.16 J	0.5
Phase 1	MW-1-2004	9/20/2010	111	9.3	0.5
Phase 2	MW-1-2004	1/27/2011	112	3.6	0.5
Phase 3	MW-1-2004	2/2/2012	109	39	2.5
Phase 3	MW-1-2004	5/15/2012	109	13	0.5
Phase 4	MW-1-2004	8/30/2012	112	46	2
Phase 4	MW-1-2004	11/28/2012	109	22	2
Phase 4	MW-1-2004	2/26/2013	101	21	1
Phase 1	MW-2-2004	9/20/2010	114	0.73	0.5
Phase 2	MW-2-2004	1/27/2011	111	<0.5 U	0.5
Phase 3	MW-2-2004	2/2/2012	110	0.92	0.5
Phase 3	MW-2-2004	5/15/2012	111	1.5	0.5
Phase 4	MW-2-2004	8/30/2012	111	1.4	0.5
Phase 4	MW-2-2004	11/28/2012	111	1	0.5
Phase 4	MW-2-2004	2/26/2013	104	2.2	0.5
Phase 2	MW-106s	1/27/2011	66	<0.5	0.5
Phase 3	MW-106s	2/2/2012	66	<0.5	0.5
Phase 3	MW-106i	2/2/2012	146	9.6	0.5
Phase 3	MW-106i	5/15/2012	145	7.8	0.5
Phase 4	MW-106i	9/5/2012	145	8.4	0.5
Phase 4	MW-106i	11/28/2012	145	4.6	0.5
Phase 4	MW-106i	2/26/2013	145	6.7	0.5
Phase 3	MW-106d	2/2/2012	197	1	0.5
Phase 3	MW-106d	5/15/2012	192	1.2 J	0.5

Sampling Event	Location ID	Collection Date	Sample Depth (ft bgs)	Result (µg/L)	Reporting Limit (µg/L)
Phase 4	MW-106d	8/30/2012	195	2.2	0.5
Phase 4	MW-106d	11/28/2012	195	2.1	0.5
Phase 4	MW-106d	2/26/2013	195	2.7	0.5
Phase 2	MW-107s	1/27/2011	66	<0.5	0.5
Phase 3	MW-107s	2/2/2012	66	<0.5	0.5
Phase 3	MW-107i	2/2/2012	145	1.2	0.5
Phase 3	MW-107i	5/15/2012	145	1	0.5
Phase 4	MW-107i	8/30/2012	145	1.1	0.5
Phase 4	MW-107i	11/28/2012	145	1.2	0.5
Phase 4	MW-107i	2/26/2013	145	1.2	0.5
Phase 3	MW-107d	2/2/2012	203	1.4	0.5
Phase 3	MW-107d	5/15/2012	200	1.3	0.5
Phase 4	MW-107d	8/30/2012	200	1.7	0.5
Phase 4	MW-107d	11/28/2012	200	1.5	0.5
Phase 4	MW-107d	2/26/2013	200	2.3	0.5
Phase 4	MW-108i	8/30/2012	149	1	0.5
Phase 4	MW-108i	11/28/2012	149	0.71	0.5
Phase 4	MW-108i	2/26/2013	149	0.88	0.5
Phase 4	MW-108d	8/30/2012	214	7.2 J	0.5
Phase 4	MW-108d	11/28/2012	214	4.7	0.5
Phase 4	MW-108d	2/26/2013	214	6.5	0.5
Phase 4	MW-109i	8/30/2012	169	0.59	0.5
Phase 4	MW-109i	11/28/2012	169	1.2	0.5
Phase 4	MW-109i	2/26/2013	167	1.5	0.5
Phase 4	MW-109d	8/30/2012	230	0.26 J	0.5
Phase 4	MW-109d	11/28/2012	230	0.21 J	0.5
Phase 4	MW-109d	2/26/2013	215	0.6	0.5
Phase 4	MW-110i	8/30/2012	208	0.3 J	0.5
Phase 4	MW-110i	11/28/2012	208	<0.5	0.5
Phase 4	MW-110i	2/26/2013	206	0.12 J	0.5
Phase 4	MW-110d	8/30/2012	301	2.2	0.5
Phase 4	MW-110d	11/28/2012	301	2.2	0.5
Phase 4	MW-110d	2/26/2013	298	2.6	0.5
Phase 2	WC#2	11/17/2011	110	<0.5	0.5
Phase 2	WC#2	11/17/2011	128	<0.5	0.5
Phase 2	WC#2	11/16/2011	148	<0.5	0.5
Phase 2	WC#2	11/16/2011	158	<0.5	0.5
Phase 2	WC#2	11/16/2011	180	<0.5	0.5
Phase 3	Freda Well	4/6/2012	196	2.8	0.5
Phase 3	Freda Well	4/6/2012	221	2.6 J	0.5
Phase 3	Freda Well	4/6/2012	336	3.9	0.5
Phase 3	Freda Well	4/6/2012	366	1.6	0.5
Phase 3	Freda Well	4/6/2012	421	2	0.5
Phase 3	Freda Well	5/15/2012	196	2.5	0.5
Phase 3	Freda Well	5/15/2012	221	5.4	0.5
Phase 3	Freda Well	5/15/2012	336	3.8	0.5
Phase 3	Freda Well	5/15/2012	366	2.2	0.5
Phase 3	Freda Well	5/15/2012	421	2.2	0.5
Phase 4	Freda Well	8/30/2012	196	3.6	0.5
Phase 4	Freda Well	8/30/2012	221	3.5	0.5
Phase 4	Freda Well	8/30/2012	336	2.8	0.5
Phase 4	Freda Well	11/28/2012	196	2.5	0.5
Phase 4	Freda Well	11/28/2012	221	2.8	0.5

Sampling Event	Location ID	Collection Date	Sample Depth (ft bgs)	Result (µg/L)	Reporting Limit (µg/L)
Phase 4	Freda Well	11/28/2012	336	3	0.5
Phase 4	Freda Well	2/26/2013	196	2.7	0.5
Phase 4	Freda Well	2/26/2013	221	5.6	0.5
Phase 4	Freda Well	2/26/2013	336	5.6	0.5

Notes:

PCE - tetrachloroethene
ID - Identification
ft - feet
bgs - below ground surface

J - associated value is estimated based on results of the data validation
U - associated value is not detected based on results of the data validation
µg/L - microgram per liter

Table 3: Comparison of Maximum Detected Concentrations of PCE to the USEPA (2013) Tap Water RSL

Groundwater Sampling Location	Maximum Detected Concentration for PCE (μg/L)	Sampling Date	Exceeds RSL (9.7 μg/L)?
FREDA[1]	5.6	2/26/2013	No
MW-101[1]	32	9/20/2010	**Yes**
MW-102	<0.5	9/20/2010	No
MW-103	0.5	1/27/2011	No
MW-104[2]	26	2/2/2012	**Yes**
MW-105	0.9	1/27/2011	No
MW-106d	2.7	2/26/2013	No
MW-106i[1]	9.6	2/2/2012	No
MW-106s	<0.5	2/2/2012	No
MW-107d	2.3	2/26/2013	No
MW-107i	1.2	2/26/2013	No
MW-107s	<0.5	2/2/2012	No
MW-108d[1]	7.2	8/30/2012	No
MW-108i	1	8/30/2012	No
MW-109d	0.6	2/26/2013	No
MW-109i	1.5	2/26/2013	No
MW-110d	2.6	2/26/2013	No
MW-110i	0.3	8/30/2012	No
MW-1-2004[2]	46	8/30/2012	**Yes**
MW-2-2004	2.2	2/26/2013	No
WC#2	0.24	5/16/2011	No

Notes:

< - PCE was not detected (value shown is the reporting limit)

PCE - tetrachloroethene

RSL - regional screening level

μg/L - micrograms per liter

USEPA - U.S. Environmental Protection Agency

[1] - Sampling location was evaluated in the screening level human health risk assessment

[2] - Sampling location was evaluated in the baseline human health risk assessment

USEPA. 2013a. USEPA Master Regional Screening Level (RSL) Table (HI=1). May.

Table 4: Comparison of Maximum Detected Concentrations of TCE to the USEPA (2013) Tap Water RSL

Groundwater Sampling Location	Maximum Detected Concentration for TCE (µg/L)	Sampling Date	Exceeds RSL (0.44 µg/L)?
FREDA[1]	0.15	8/30/2012	No
MW-101[1]	0.61	1/27/2011	**Yes**
MW-102	<0.5	9/20/2010	No
MW-103	<0.5	2/26/2013	No
MW-104[2]	0.32	2/26/2013	No
MW-105	<0.5	2/26/2013	No
MW-106d	0.13	5/15/2012	No
MW-106i[1]	<0.5	2/26/2013	No
MW-106s	<0.5	2/2/2012	No
MW-107d	<0.5	2/26/2013	No
MW-107i	<0.5	2/26/2013	No
MW-107s	<0.5	2/2/2012	No
MW-108d[1]	<0.5	2/26/2013	No
MW-108i	<0.5	2/26/2013	No
MW-109d	<0.5	2/26/2013	No
MW-109i	<0.5	2/26/2013	No
MW-110d	<0.5	2/26/2013	No
MW-110i	<0.5	2/26/2013	No
MW-1-2004[2]	0.48	2/2/2012	**Yes**
MW-2-2004	<0.5	2/26/2013	No
WC#2	<0.5	11/17/2011	No

Notes:
< - TCE was not detected (value shown is the reporting limit)
RSL - regional screening level
TCE - trichloroethene
µg/L - micrograms per liter
USEPA - U.S. Environmental Protection Agency
[1] - Sampling location was evaluated in the screening level human health risk assessment
[2] - Sampling location was evaluated in the baseline human health risk assessment

USEPA. 2013a. USEPA Master Regional Screening Level (RSL) Table (HI=1). May.

Table 5: Exposure Factor Parameter Values for Domestic Use of Groundwater by Child and Adult

Exposure Pathway	Parameter	Description	Exposure Parameters	
			RME	Source
Groundwater Ingestion	GWIRc	Groundwater Ingestion Rate, child (L/day)	1	(1)
	GWIRa	Groundwater Ingestion Rate, adult (L/day)	2	(2)
	GWIRadj	Age-adjusted groundwater ingestion rate (L-year/kg-day)	1.086	calculated(3)
	BWc	Body Weight, child (kg)	15	(2)
	BWa	Body Weight, adult (kg)	70	(4)
	EDc	Exposure Duration, child (years)	6	(2)
	EDa	Exposure Duration, adult (years)	24	(2)
	EF	Exposure Frequency (days/year)	350	(2)
	ATnc	Averaging Time for Noncarcinogens (days)	10950	(4)
	ATc	Averaging Time for Carcinogens (days)	25550	(4)
Dermal Contact with Groundwater	SAc	Skin Surface Area Exposed, child (cm^2)	6600	(5)
	SAa	Skin Surface Area Exposed, adult (cm^2)	18000	(5)
	GWCRadj	Age-adjusted groundwater contact rate (cm2-hours-year/kg-day)	6219	calculated(6)
	ETc	Exposure time, child (hours/day)	1	(5)
	ETa	Exposure time, adult (hours/day)	0.58	(5)
	BWc	Body Weight, child (kg)	15	(2)
	BWa	Body Weight, adult (kg)	70	(4)
	CF	Conversion Factor (cm3/L)	1000	-
	PC	Permeability constant (cm/hour)	chemical specific	-
	EDc	Exposure Duration, child (years)	6	(2)
	EDa	Exposure Duration, adult (years)	24	(2)
	EF	Exposure Frequency (days/year)	350	(2)
	ATnc	Averaging Time for Noncarcinogens (days)	10950	(4)
	ATc	Averaging Time for Carcinogens (days)	25550	(4)
Inhalation of VOCs in Indoor Air During Household Use of Groundwater	ET	Exposure Time (hours/day)	24	(7)
	EF	Exposure Frequency (days/year)	350	(2)
	EDt	Exposure Duration, total (years)	30	(2)
	VF	Volatilization Factor (L/m3)	0.5	(8)
	ATnc	Averaging Time for Noncarcinogens (hours)	262800	(9)
	ATc	Averaging Time for Carcinogens (hours)	613200	(9)

Notes:

(1) USEPA (2004a)
(2) USEPA (1991a)
(3) GWIRadj = (GWIRc x EDc/BWc) + (GWIRa x EDa/BWa)
(4) USEPA (1989)
(5) USEPA (2004b)
(6) GWCRadj = (SAc x ETc x EDc/BWc) + (SAa x ETa x EDc/BWa)
(7) USEPA (2009)
(8) USEPA (1991b)
(9) Averaging time in days x 24 hours/day (USEPA 2009)
cm/hour - centimeters per hour
cm2 - squared centimeters
cm2-hours-year/kg-day - squared centimeters-hours-year per kilogram-day
cm3/L - cubed centimeters per liter
kg - kilograms
L/day - Liters per day
L/m3 - liters per cubed meter
L-year/kg-day - liter-year per kilogram-day
RME - Reasonable Maximum Exposure
VOC - Volatile organic compound

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Table 6: Concentrations of PCE in MW-1-2004

Sample Location	Sample ID	Collection Date	Sample Type	Qualifier	PCE Concentration (µg/L)	MDL	RL
MW-1-2004	5P-MW1-2004-109DL	2/2/2012	Normal	=	39	0.0758	2.5
MW-1-2004	5P-MW12004-109112	5/15/2012	Normal	=	13	0.0758	0.5
MW-1-2004	5P-MW12004-112DL	8/30/2012	Normal	=	46	0.0758	2
MW-1-2004	5P-MW12004-112-YDL	8/30/2012	Field Duplicate	=	42	0.0758	2
MW-1-2004	5P-MW1-2004-109DL	11/28/2012	Normal	=	22	0.0758	2
MW-1-2004	5P-MW1-2004-YDL	11/28/2012	Field Duplicate	=	19	0.0758	2
MW-1-2004	5P-MW1-2004-101DL	2/26/2013	Normal	=	21*	0.0758	1
MW-1-2004	5P-MW91-101DL	2/26/2013	Field Duplicate	=	16	0.0758	2
		Maximum Concentration			46		
		Exposure Point Concentration (Most Recent Sample)			21		

Notes:

= - PCE was de PCE was detected

MDL - method method detection limit

PCE - tetrachlc tetrachloroethene

RL - reporting limit

µg/L - micrograms per liter

* - Value used in selection of exposure point concentration

Table 7: Concentrations of PCE in MW-104

Sample Location	Sample ID	Collection Date	Sample Type	Qualifier	PCE Concentration (µg/L)	MDL	RL
MW-104	5P-MW104-120DL	2/2/2012	Normal	=	26	0.0758	2
MW-104	5P-MW104-119122	5/15/2012	Normal	=	14	0.0758	0.5
MW-104	5P-MW104-120	8/30/2012	Normal	=	18	0.0758	0.5
MW-104	5P-MW-104-120	11/28/2012	Normal	=	14	0.0758	0.5
MW-104	5P-MW104-120DL	2/26/2013	Normal	=	21	0.0758	2
		Maximum Concentration			26		
		Exposure Point Concentration (Most Recent Sample)			21		

Notes:

= - PCE was detected
MDL - method detection limit
PCE - tetrachloroethene
RL - reporting limit
µg/L - micrograms per liter

Table 8: Summary of Cancer Risks and Hazard Indicies for MW-1-2004 and MW-104

MW-1-2004		
Exposure	**CR**	**HI**
PCE	1.90E-06	3.96E-01
TCE	6.14E-07	1.22E-01
Total CR/HI	**3.00E-06**	**5.00E-01**
MW-104		
Exposure	**CR**	**HI**
PCE	1.90E-06	3.96E-01
TCE	5.04E-07	1.00E-01
Total CR/HI	**2.00E-06**	**5.00E-01**

Notes:

CR - cancer risk

HI - hazard index

PCE - tetrachloroethene

TCE - trichloroethene

Table 9: Detailed Analysis of Remedial Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Extraction, Containment, and Treatment at Plume Toe	Alternative 3 Extraction, Containment, and Treatment at Plume Core	Alternative 4 Extraction,Containment, and Treatment at Plume Core and at Plume Toe	Alternative 5 Extraction, Containment, and Treatment at Plume Toe and ISCO at Plume Core
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT					
Protection of Human Health	Does not provide protection of human health.	Groundwater extraction will result in hydraulic containment which will prevent migration of impacted groundwater to public drinking water wells. ICs that limit well drilling will ensure a future land use consistent with the RAOs.	Groundwater extraction will result in hydraulic containment which will prevent migration of the higher concentration plume core and will reduce plume volume. Continued pumping from New Well and Freda Well would be required to prevent further migration at the plume toe. ICs that limit well drilling will ensure a future land use consistent with the RAOs.	Groundwater extraction will result in hydraulic containment which will prevent migration of impacted groundwater to public drinking water wells. ICs that limit well drilling will ensure a future land use consistent with the RAOs.	Groundwater extraction will result in hydraulic containment which will prevent migration of impacted groundwater to public drinking water wells. ICs that limit well drilling will ensure a future land use consistent with the RAOs.
Protection of the Environment	Does not provide protection of the environment.	Hydraulic containment prevents further migration of impacted groundwater.	Hydraulic containment prevents further migration of impacted groundwater at the higher concentration plume core.	Hydraulic containment prevents further migration of impacted groundwater at the plume toe and prevents further migration of the higher concentration plume core.	Hydraulic containment prevents further migration of impacted groundwater. ISCO reduces plume concentrations and prevents further migration of the higher concentration plume core.
COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)					
Chemical-specific ARAR	Chemical-specific ARARs could be met in a reasonable time frame.	It is expected that all chemical-specific ARARs will be met.	It is expected that all chemical-specific ARARs will be met.	It is expected that all chemical-specific ARARs will be met.	It is expected that all chemical-specific ARARs will be met.
Action-specific ARAR	Action-specific ARARs will not be met.	It is expected that all action-specific ARARs will be met.	It is expected that all action-specific ARARs will be met.	It is expected that all action-specific ARARs will be met.	It is expected that all action-specific ARARs will be met.
Location-specific ARAR	Location-specific ARARs will not be met.	It is expected that all location-specific ARARs will be met.	It is expected that all location-specific ARARs will be met.	It is expected that all location-specific ARARs will be met.	It is expected that all location-specific ARARs will be met.
LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of residual risk	Environmental impacts and the risk to human health and the environment will remain unchanged.	Hydraulic containment will mitigate risk while the extraction system is in operation. Once RAOs are achieved, there will be no residual risk.	Hydraulic containment will mitigate risk while the extraction system is in operation. Once RAOs are achieved, there will be no residual risk.	Hydraulic containment will mitigate risk while the extraction system is in operation. Once RAOs are achieved, there will be no residual risk. Containment at the plume core will reduce the time frame of long-term operation and prevent migration of the higher concentration plume core.	Hydraulic containment will mitigate risk while system is in operation. Once RAOs are achieved, there will be no residual risk. Treatment at the plume core will reduce the time frame of long-term operation and prevent migration of the higher concentration plume core.
Adequacy and reliability of controls	No controls will be implemented	Hydraulic containment will prevent impacted groundwater from migrating to drinking water wells. Contaminant removal will be permanent. Institutional controls will effectively limit well drilling and groundwater use as long as controls are in place.	Hydraulic containment will prevent migration of the higher concentration plume core. Contaminant removal will be permanent. Institutional controls will effectively limit well drilling and groundwater use as long as controls are in place.	Hydraulic containment will prevent impacted groundwater from migrating to drinking water wells. Contaminant removal will be permanent. Institutional controls will effectively limit well drilling and groundwater use as long as controls are in place.	Hydraulic containment will prevent impacted groundwater from migrating to drinking water wells. Contaminant removal will be permanent. Institutional controls will effectively limit well drilling and groundwater use as long as controls are in place.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME					
Amount of hazardous material destroyed or treated	None, attenuation of the existing plume will consist of dilution by diffusion and dispersion.	Extraction, treatment, and hydraulic containment will slightly reduce plume volume.	Extraction, treatment and hydraulic containment will reduce plume volume.	Extraction, treatment and hydraulic containment will reduce plume volume.	Hydraulic containment and ISCO will reduce plume volume.
Amount of hazardous material remaining onsite	Existing plume will remain for greater than 30 years.	The existing PCE plume will remain for approximately 30 years.	The existing PCE plume will remain for approximately 25 years.	The existing PCE plume will remain for approximately 20 years.	The existing PCE plume will remain for approximately 25 years.

Criteria	Alternative 1 No Action	Alternative 2 Extraction, Containment, and Treatment at Plume Toe	Alternative 3 Extraction, Containment, and Treatment at Plume Core	Alternative 4 Extraction,Containment, and Treatment at Plume Core and at Plume Toe	Alternative 5 Extraction, Containment, and Treatment at Plume Toe and ISCO at Plume Core
Reduction of mobility, toxicity, or volume	None	Reduces the mobility of contaminants by altering the groundwater flow characteristics. No impacts are expected to migrate beyond the zone of hydraulic containment, thereby removing toxicity, mobility, and volume of impacts that can migrate to downgradient drinking water wells. Toxicity, mobility, or volume of the plume as a whole are not effectively treated.	Reduces the mobility of contaminants by altering the groundwater flow characteristics. No impacts are expected to migrate beyond the zone of hydraulic containment, thereby removing toxicity, mobility, and volume of impacts that can migrate downgradient. The overall plume mass will be reduced by groundwater extraction.	Reduces the mobility of contaminants by altering the groundwater flow characteristics. No impacts are expected to migrate beyond the zone of hydraulic containment, thereby removing toxicity, mobility, and volume of impacts that can migrate to downgradient drinking water wells. Extraction and treatment reduces volume/mobility of the plume core and stops plume migration beyond the containment area.	Reduces the mobility of contaminants by altering the groundwater flow characteristics. No impacts are expected to migrate beyond the zone of hydraulic containment, thereby removing toxicity, mobility, and volume of impacts that can migrate to downgradient drinking water wells. ISCO reduces volume/toxicity of the plume core and stops the plume from migrating beyond the treatment zone.
Irreversible treatment	None	No residual source area is believed to exist. Contaminant removal due to extraction and treatment is irreversible.	No residual source area is believed to exist. Contaminant removal due to extraction and treatment is irreversible.	No residual source area is believed to exist. Contaminant removal due to extraction and treatment is irreversible.	No residual source area is believed to exist. Contaminant removal due to hydraulic containment and ISCO treatment is irreversible.
SHORT-TERM EFFECTIVENESS					
Time required to achieve protection	No protection provided.	3 months	3 months	3-6 months	9-12 months
Short term reliability	Continued impact from existing conditions.	Remedy is reliable and operational requirements are well understood.	Remedy is reliable and operational requirements are well understood.	Remedy is reliable and operational requirements are well understood.	Remedy is reliable and operational requirements are well understood.
Protection of the community during remediation	Protection of the community is not provided as groundwater impacts are able to migrate to public drinking water wells.	Protection of the community is provided by preventing groundwater impacts from migrating to public drinking water wells. There will be no additional risk to the community during remediation. There will be no closure of business required to maintain protection of human health during implementation.	Protection of the community is provided by preventing groundwater impacts from migrating to public drinking water wells. There will be no additional risk to the community during remediation. There will be no closure of business required to maintain protection of human health during implementation; however there will be moderate disruption to residential neighborhoods during construction.	Protection of the community is provided by preventing groundwater impacts from migrating to public drinking water wells. There will be no additional risk to the community during remediation. There will be no closure of business required to maintain protection of human health during implementation. Disruption to residential neighborhoods will be moderate during construction.	Protection of the community is provided by preventing groundwater impacts from migrating to public drinking water wells. There will be a small risk to the community during remediation from daylighting or contact of chemical oxidants, which can be mitigated during injection activities by using safe practices. There will be no closure of business required to maintain protection of human health during implementation. Disruption to residential neighborhoods will be significant during construction and injection.
Protection of workers during remediation	No risks, as there are no workers.	There is a low level of risk to workers during remediation. Proper personal protective equipment such as nitrile gloves will mitigate the risk of exposure. Typical safety equipment will mitigate risks during installation.	There is a low level of risk to workers during remediation. Proper personal protective equipment such as nitrile gloves will mitigate the risk of exposure. Typical safety equipment will mitigate risks during installation.	There is a low level of risk to workers during remediation. Proper personal protective equipment such as nitrile gloves will mitigate the risk of exposure. Typical safety equipment will mitigate risks during installation.	There is a moderate level of risk to workers during remediation during handling of chemical oxidant. Proper personal protective equipment such as nitrile gloves will mitigate the risk of exposure. Typical safety equipment will mitigate risks during injection.

Table 9: Detailed Analysis of Remedial Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Extraction, Containment, and Treatment at Plume Toe	Alternative 3 Extraction, Containment, and Treatment at Plume Core	Alternative 4 Extraction,Containment, and Treatment at Plume Core and at Plume Toe	Alternative 5 Extraction, Containment, and Treatment at Plume Toe and ISCO at Plume Core
IMPLEMENTABILITY					
Ability to construct, operate, and maintain the technology	No construction, operation, or maintenance.	Extraction, containment, and treatment are well known technologies and are widely understood. Standard construction techniques are required to construct, operate, and maintain the remedial alternative.	Extraction, containment, and treatment are well known technologies and are widely understood. Standard construction techniques are required to construct, operate, and maintain the remedial alternative.	Extraction, containment, and treatment are well known technologies and are widely understood. Standard construction techniques are required to construct, operate, and maintain the remedial alternative.	Extraction, containment, and treatment are well known technologies and are widely understood. Standard construction techniques are required to construct, operate, and maintain the remedial alternative. ISCO requires a specialized injection contractor which is readily available.
Ability to phase in other actions	Other actions easily phased in.	Other actions can easily be phased in and would not interrupt the remedy.	Other actions can easily be phased in and would not interrupt the remedy.	Other actions can easily be phased in and would not interrupt the remedy.	Other actions can easily be phased in and would not interrupt the remedy.
Ease of undertaking additional remedial actions	Additional remedial actions could easily be performed.	Additional remedial actions could easily be performed and would not interrupt the remedy.	Additional remedial actions could easily be performed and would not interrupt the remedy.	Additional remedial actions could easily be performed and would not interrupt the remedy.	Additional remedial actions could easily be performed and would not interrupt the remedy.
Ability to monitor effectiveness of the remedy	Not applicable	Effectiveness of hydraulic containment can easily be monitored with water level elevation measurements and system influent/effluent sampling.	Effectiveness of extraction and treatment can easily be monitored with water level elevation measurements and system influent/effluent sampling.	Effectiveness of extraction, treatment, and hydraulic containment can easily be monitored with water level elevation measurements and system influent/effluent sampling.	Effectiveness of extraction, treatment, and hydraulic containment can easily be monitored with water level elevation measurements and system influent/effluent sampling. Effectiveness of injection will be monitored based on VOC concentrations within and downgradient of the treatment area as well as groundwater geochemistry.
Ability to obtain approvals and permits from other agencies	Not applicable	Moderate level of coordination with local POTW for groundwater disposal, and state agencies for water rights.	Moderate level of coordination with local POTW for groundwater disposal, and state agencies for water rights.	Moderate level of coordination with local POTW for groundwater disposal, and state agencies for water rights.	Moderate level of coordination with local POTW for groundwater disposal, and state agencies for water rights. Moderate level of coordination with state, local, and federal agencies for injection.
Coordination with other agencies	Not applicable	Coordination with local POTW and state agencies.	Coordination with local POTW and state agencies.	Coordination with local POTW and state agencies.	Coordination with local POTW, local, state, and federal agencies.
Availability of waste treatment, storage, and disposal facilities	Not applicable	Extracted groundwater treatment readily available, if needed.	Extracted groundwater treatment readily available, if needed.	Extracted groundwater treatment readily available, if needed.	Extracted groundwater treatment readily available, if needed.
Availability of equipment and specialists	Not applicable	Equipment is readily available from various sources.	Equipment is readily available from various sources.	Equipment is readily available from various sources.	Equipment and specialists are readily available from various sources.
COST					
Capital cost	$0	$731,000	$481,000	$1,212,000	$3,364,000
30-year O&M cost	$0	$2,639,000	$2,245,000	$2,874,000	$5,733,000
Present worth cost @ 30 yrs & 2.8% Discount Factor	$0	$3,370,000	$2,725,000	$4,086,000	$9,097,000
STATE ACCEPTANCE	Not acceptable	Acceptable	Acceptable	Acceptable	Acceptable
COMMUNITY ACCEPTANCE	Not acceptable	Acceptable	Acceptable	Acceptable	Acceptable

Table 10: Comparison Cost Summary for each Alternative

Alternative	Description	Capital Cost	O&M Cost	Total Present Worth
Alternative 2	Extraction, Containment, and Treatment at Plume Toe	$731,000	$2,639,000	$3,370,000
Alternative 3	Extraction, Containment, and Treatment at Plume Core	$481,000	$2,245,000	$2,725,000
Alternative 4	Extraction, Containment, and Treatment at Plume Core and at Plume Toe	$1,212,000	$2,874,000	$4,086,000
Alternative 5	Extraction, Containment, and Treatment at Plume Toe and ISCO at Plume Core	$3,364,000	$5,733,000	$9,097,000

Selected Remedy					
Extraction, Containment, and Treatment at Plume Core and at Plume Toe					
Description	**Quantity**	**Units**	**Unit Cost**	**Cost**	**Notes**
CAPITAL COSTS (Plume Core)					
Institutional controls					
Groundwater Use Restrictions	1	Lump Sum	$10,000	$10,000	(6)
Monitoring Well Installation					
Number of wells (170' bgs)	3	--	--	--	
Driller Mobilization/Demobilization	1	Lump Sum	$5,000	$5,000	(5)
Driller Per Diem	13	Day	$450	$5,850	(5)
Drill 4"x 6" Sonic continuous core (2" well to 170')	510	Linear Feet	$60	$30,600	(5)
Drill 6"x 9" Sonic continuous core (4" well to 170')	0	Linear Feet	$75	$0	(5)
Driller move, set up , decon, clean up, water haul	16	Hour	$450	$7,200	(5)
Install 2" PVC Well	510	Linear Feet	$28	$14,280	(5)
Install 4" PVC Well	0	Linear Feet	$35	$0	(5)
Boring Abandonment	0	Linear Feet	$10	$0	(5)
Flush Mount Completion	3	Each	$300	$900	(5)
2'x2' well vault	0	Each	$800	$0	(5)
Above grade completion (protector, posts, pad)	0	Each	$1,200	$0	(5)
Bobcat, skid steer or forklift	13	Days	$250	$3,250	(5)
Driller stand by rate	0	Hours	$450	$0	(5)
Driller crew rotation	1	Each	$1,800	$1,800	(5)
Mobilization/Demobilization development rig and crew	1	Lump Sum	$2,500	$2,500	(5)
Well development (5 hours each)	15	Hours	$225	$3,375	(5)
Well development per diem	2	Days	$250	$500	(5)
Temporary Decon Pad	1	Each	$800	$800	(5)
Well installation oversight	130	Hours	$100	$13,000	(6)
Field Equipment	13	Days	$100	$1,300	(6)
Field vehicle	13	Days	$100	$1,300	(6)
Surveying	6	Hours	$150	$900	(6)
Extraction Well Installation					
Number of wells (170' bgs)	1	--	--	--	
Driller Mobilization/Demobilization	1	Lump Sum	$5,000	$5,000	(5)
Driller Per Diem	3	Day	$450	$1,350	(5)
Drill 4"x 6" Sonic continuous core (2" well to 170')	0	Linear Feet	$60	$0	(5)
Drill 6"x 9" Sonic continuous core (4" well to 170')	170	Linear Feet	$75	$12,750	(5)
Driller move, set up , decon, clean up, water haul	4	Hour	$450	$1,800	(5)
Install 2" PVC Well	0	Linear Feet	$28	$0	(5)
Install 4" PVC Well	170	Linear Feet	$35	$5,950	(5)
Boring Abandonment	0	Linear Feet	$10	$0	(5)
Flush Mount Completion	0	Each	$300	$0	(5)
2'x2' well vault	1	Each	$800	$800	(5)
Above grade completion (protector, posts, pad)	0	Each	$1,200	$0	(5)
Bobcat, skid steer or forklift	3	Days	$250	$750	(5)
Driller stand by rate	0	Hours	$450	$0	(5)
Driller crew rotation	0	Each	$1,800	$0	(5)
Mobilization/Demobilization development rig and crew	1	Lump Sum	$2,500	$2,500	(5)
Well development (5 hours each)	5	Hours	$225	$1,125	(5)
Well development per diem	1	Days	$250	$250	(5)
Temporary Decon Pad	0	Each	$800	$0	(5)
Well installation oversight	30	Hours	$100	$3,000	(6)
Field Equipment	3	Days	$100	$300	(6)
Field vehicle	3	Days	$100	$300	(6)
Surveying	2	Hours	$150	$300	(6)
Submersible pump	1	Each	$6,000	$6,000	(6)(8)
2-inch discharge tube, polyethylene	170	Linear Feet	$4	$680	(6)
Wellhead piping, level controls, electrical	1	Each	$3,000	$3,000	(6)
IDW Management (Transportation and Disposal)					
Soil cuttings 2" wells	3	Tons	$75	$193	(6)
Soil cuttings 4" wells	7	Tons	$75	$556	(6)
Roll-off container rental (10 tons each)	1	Each	$500	$500	(6)
Purge and Development Water (POTW Costs)	1237	Gallons	$0.0003	$0.37	(9)
Water tank rental	2	Months	$250	$500	(6)

Description	Quantity	Units	Unit Cost	Cost	Notes
TCLP VOC, SVOC, Metals Analysis for Soil	1	Each	$510	$510	(4)
TCLP VOC, SVOC, Metals Analysis for Water	1	Each	$440	$440	(4)
Groundwater Extraction System					
Conveyance piping (2 inch HDPE)	250	Linear Feet	$45	$11,250	(6)
Trenching	250	Linear Feet	$50	$12,500	(6)
1500 gallon EQ tank, 3hp pump, level controls, valves	1	Each	$10,000	$10,000	(6)
Electrical	1	Lump Sum	$2,500	$2,500	(6)
GAC Vessel Purchase and Freight (2 vessels)	1	Lump Sum	$50,000	$50,000	(10)
Metering pump	1	Lump Sum	$1,000	$1,000	(6)
System building	1	Lump Sum	$20,000	$20,000	(6)
Discharge piping to POTW	500	Linear Feet	$45	$22,500	(6)
Sanitary Sewer Tie In	1	Lump Sum	$500	$500	(6)
System installation oversight	80	Hours	$100	$8,000	(6)
Field Equipment	10	Days	$100	$1,000	(6)
Field vehicle	10	Days	$100	$1,000	(6)
Contingency and Markups					
Bid Contingency	10	Percent	NA	$29,136	(6)
Construction Management	25	Percent	NA	$72,840	(7)
Misc. unscoped items	5	Percent	NA	$14,568	(6)
Permitting and Legal	5	Percent	NA	$14,568	(6)
Engineering and Design Cost	20	Percent	NA	$58,272	(7)
TOTAL CAPITAL COSTS (Plume Core)				**$480,743**	
CAPITAL COSTS (Plume Toe)					
Institutional controls					
Groundwater Use Restrictions	1	Lump Sum	$10,000	$10,000	(6)
Monitoring Well Installation					
Number of wells (330' bgs)	4	--	--	--	
Driller Mobilization/Demobilization	1	Lump Sum	$5,000	$5,000	(5)
Driller Per Diem	17	Day	$450	$7,650	(5)
Drill 4"x 6" Sonic continuous core (2" well to 330')	1320	Linear Feet	$60	$79,200	(5)
Drill 6"x 9" Sonic continuous core (4" well to 330')	0	Linear Feet	$75	$0	(5)
Driller move, set up , decon, clean up, water haul	16	Hour	$450	$7,200	(5)
Install 2" PVC Well	1320	Linear Feet	$28	$36,960	(5)
Install 4" PVC Well	0	Linear Feet	$35	$0	(5)
Boring Abandonment	0	Linear Feet	$10	$0	(5)
Flush Mount Completion	4	Each	$300	$1,200	(5)
2'x2' well vault	0	Each	$800	$0	(5)
Above grade completion (protector, posts, pad)	0	Each	$1,200	$0	(5)
Bobcat, skid steer or forklift	17	Days	$250	$4,250	(5)
Driller stand by rate	0	Hours	$450	$0	(5)
Driller crew rotation	1	Each	$1,800	$1,800	(5)
Mobilization/Demobilization development rig and crew	1	Lump Sum	$2,500	$2,500	(5)
Well development (5 hours each)	20	Hours	$225	$4,500	(5)
Well development per diem	3	Days	$250	$750	(5)
Temporary Decon Pad	1	Each	$800	$800	(5)
Well installation oversight	170	Hours	$100	$17,000	(6)
Field Equipment	17	Days	$100	$1,700	(6)
Field vehicle	17	Days	$100	$1,700	(6)
Surveying	6	Hours	$150	$900	(6)
Extraction Well Installation					
Number of wells (330' bgs)	1	--	--	--	
Driller Mobilization/Demobilization	1	Lump Sum	$5,000	$5,000	(5)
Driller Per Diem	5	Day	$450	$2,250	(5)
Drill 4"x 6" Sonic continuous core (2" well to 330')	0	Linear Feet	$60	$0	(5)
Drill 6"x 9" Sonic continuous core (4" well to 330')	330	Linear Feet	$75	$24,750	(5)
Driller move, set up , decon, clean up, water haul	4	Hour	$450	$1,800	(5)
Install 2" PVC Well	0	Linear Feet	$28	$0	(5)
Install 4" PVC Well	330	Linear Feet	$35	$11,550	(5)
Boring Abandonment	0	Linear Feet	$10	$0	(5)
Flush Mount Completion	0	Each	$300	$0	(5)
2'x2' well vault	1	Each	$800	$800	(5)
Above grade completion (protector, posts, pad)	0	Each	$1,200	$0	(5)

Description	Quantity	Units	Unit Cost	Cost	Notes
Bobcat, skid steer or forklift	5	Days	$250	$1,250	(5)
Driller stand by rate	0	Hours	$450	$0	(5)
Driller crew rotation	0	Each	$1,800	$0	(5)
Mobilization/Demobilization development rig and crew	1	Lump Sum	$2,500	$2,500	(5)
Well development (5 hours each)	5	Hours	$225	$1,125	(5)
Well development per diem	1	Days	$250	$250	(5)
Temporary Decon Pad	0	Each	$800	$0	(5)
Well installation oversight	50	Hours	$100	$5,000	(6)
Field Equipment	5	Days	$100	$500	(6)
Field vehicle	5	Days	$100	$500	(6)
Surveying	2	Hours	$150	$300	(6)
Submersible pump	1	Each	$4,000	$4,000	(6)(8)
2-inch discharge tube, polyethylene	330	Linear Feet	$4	$1,320	(6)
Wellhead piping, level controls, electrical	1	Each	$3,000	$3,000	(6)
IDW Management (Transportation and Disposal)					
Soil cuttings 2" wells	7	Tons	$75	$499	(6)
Soil cuttings 4" wells	14	Tons	$75	$1,079	(6)
Roll-off container rental (10 tons each)	2	Each	$500	$1,000	(6)
Purge and Development Water (POTW Costs)	1436	Gallons	$0.0003	$0.43	(9)
Water tank rental	2	Months	$250	$500	(6)
TCLP VOC, SVOC, Metals Analysis for Soil	1	Each	$510	$510	(4)
TCLP VOC, SVOC, Metals Analysis for Water	1	Each	$440	$440	(4)
Groundwater Extraction System					
Conveyance piping (2 inch HDPE)	250	Linear Feet	$45	$11,250	(6)
Trenching	250	Linear Feet	$50	$12,500	(6)
1500 gallon EQ tank, 3hp pump, level controls, valves	1	Each	$10,000	$10,000	(6)
Electrical	1	Lump Sum	$2,500	$2,500	(6)
GAC Vessel Purchase and Freight (2 vessels)	1	Lump Sum	$100,000	$100,000	(10)
Metering pump	1	Lump Sum	$1,000	$1,000	(6)
System building	1	Lump Sum	$20,000	$20,000	(6)
Discharge piping to POTW	500	Linear Feet	$45	$22,500	(6)
Sanitary Sewer Tie In	1	Lump Sum	$500	$500	(6)
System installation oversight	80	Hours	$100	$8,000	(6)
Field Equipment	10	Days	$100	$1,000	(6)
Field vehicle	10	Days	$100	$1,000	(6)
Contingency and Markups					
Bid Contingency	10	Percent	NA	$44,328	(6)
Construction Management	25	Percent	NA	$110,821	(7)
Misc. unscoped items	5	Percent	NA	$22,164	(6)
Permitting and Legal	5	Percent	NA	$22,164	(6)
Engineering and Design Cost	20	Percent	NA	$88,657	(7)
TOTAL CAPITAL COSTS (Plume Toe)				**$731,418**	
TOTAL CAPITAL COSTS				**$1,212,161**	
ANNUAL O&M COSTS					
System Operation and Monitoring (Plume Core)					
GAC Vessel Exchange/Disposal (Quarterly)	1	Each	$4,000	$4,000	(10)
Electricity	12	Months	$2,000	$24,000	(6)
Sequestering Agent	12	Months	$2,000	$24,000	(6)
Disposal to POTW	105	M Gallons	$300	$31,536	(9) 200 gpm
Influent/Midpoint/Effluent Sampling (4 quarters)	32	Hours	$100	$3,200	(6)
System Maintenance (4 quarters)	24	Hours	$100	$2,400	(6)
Analyze Samples for VOCs (4 quarters)	12	Each	$75	$900	(3)(4)
Groundwater Levels (4 quarters)	32	Hours	$100	$3,200	(6)
Sampling Equipment	4	Days	$100	$400	(6)
Field vehicle	4	Days	$100	$400	(6)
System Operation and Monitoring (Plume Toe)					
GAC Vessel Exchange/Disposal (Quarterly)	0.5	Each	$6,000	$3,000	(10)
Electricity	12	Months	$2,000	$24,000	(6)
Sequestering Agent	12	Months	$2,000	$24,000	(6)
Disposal to POTW	158	M Gallons	$300	$47,304	(9) 300 gpm
Influent/Midpoint/Effluent Sampling (4 quarters)	32	Hours	$100	$3,200	(6)
System Maintenance (4 quarters)	24	Hours	$100	$2,400	(6)

Description	Quantity	Units	Unit Cost	Cost	Notes
Analyze Samples for VOCs (4 quarters)	12	Each	$75	$900	(3)(4)
Groundwater Levels (4 quarters)	32	Hours	$100	$3,200	(6)
Sampling Equipment	4	Days	$100	$400	(6)
Field vehicle	4	Days	$100	$400	(6)
Semi-Annual Sitewide Monitoring					
Groundwater Sampling (2 events)	48	Hours	$100	$4,800	(6)
Analyze Samples for VOCs (2 events)	63	Each	$75	$4,725	(1)(2)(4)
Sampling Equipment	6	Days	$100	$600	(6)
Field vehicle	6	Days	$100	$600	(6)
Reporting					
Data Validation, Interpretation, Semi-Annual and Annual Report	1	Lump Sum	$40,000	$40,000	(6)
Contingency and Markups					
Misc. unscoped items	5	Percent	NA	$0	(6)
O&M Technical Support	20	Percent	NA	$0	(6)
TOTAL ANNUAL O&M COSTS				**$253,565**	

Notes:

(1) 19 Monitoring Wells: MW-101, MW-102, MW-103, MW-104, MW-105, MW-106S, MW-106I, MW-106D, MW-107S, MW-107I, MW-107D, MW-109D, MW-110I, MW-110D, MW1-2004, MW2-2004, and 7 new wells

(2) Samples for quality assurance/quality control (QA/QC) will be collected at a rate of 20% of the normal samples.

(3) QA/QC samples will not be collected for system influent/effluent monitoring or waste characterization.

(4) Costs based on 8/23/13 ALS Group USA estimate

(5) Costs based on 8/27/13 Cascade Drilling estimate

(6) Engineers estimate

(7) from EPA's "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", July 2000.

(8) Grundfos Model 230S100-4BC, or equivalent.

(9) South Davis Sewer District cost estimate of $0.30/1000 gallons

(10) Carbonair budgetary proposal dated 6/20/14, updated 10/28/14

Table 12: Present Worth Analysis for the Selected Remedy

Year	Capital Cost	Annual O&M Cost	Subtotal Annual Expenditures	Discount Factor[1] 7.0%	Present Worth[2]
0	$1,212,161	$253,565	$1,465,726	1.000	$1,465,726
1		$253,565	$253,565	0.935	$236,977
2		$253,565	$253,565	0.873	$221,473
3		$253,565	$253,565	0.816	$206,985
4		$253,565	$253,565	0.763	$193,444
5		$253,565	$253,565	0.713	$180,788
6		$253,565	$253,565	0.666	$168,961
7		$253,565	$253,565	0.623	$157,908
8		$253,565	$253,565	0.582	$147,577
9		$253,565	$253,565	0.544	$137,923
10		$253,565	$253,565	0.508	$128,900
11		$253,565	$253,565	0.475	$120,467
12		$253,565	$253,565	0.444	$112,586
13		$253,565	$253,565	0.415	$105,220
14		$253,565	$253,565	0.388	$98,337
15		$253,565	$253,565	0.362	$91,904
16		$253,565	$253,565	0.339	$85,891
17		$253,565	$253,565	0.317	$80,272
18		$253,565	$253,565	0.296	$75,021
19		$253,565	$253,565	0.277	$70,113
20		$0	$0	0.258	$0
21		$0	$0	0.242	$0
22		$0	$0	0.226	$0
23		$0	$0	0.211	$0
24		$0	$0	0.197	$0
25		$0	$0	0.184	$0
26		$0	$0	0.172	$0
27		$0	$0	0.161	$0
28		$0	$0	0.150	$0
29		$0	$0	0.141	$0
Present Worth of Capital Cost					$1,212,000
Present Worth of O&M Cost					$2,874,000
Total Present Worth (30 Years)					**$4,086,000**

Notes:

[1] - Discount rate of 7% and inflation rate of 0% were based on guidance from Section 4.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", (USEPA. 2000).

Discount factor = 1/(1+Discount Rate^(Year)).

[2] - Present Worth = Annual expenditures x Inflation Factor x Discount Factor. Inflation Factor = 1. Cost rounded to the closest $1000.

Table 13: Chemical-Specific ARARs

Standard, Requirement, Criteria or Limitation	Citation	Description	ARARs Determination	Comment
State of Utah Regulations				
Primary Drinking Water Standards	UAC R309-200-5	Establishes primary drinking water MCLs for inorganic and organic chemicals including PCE.	Relevant and appropriate	MCLs for drinking water are relevant and appropriate as minimum cleanup standards for CERCLA sites as required under UAC R311-211-5. MCL for PCE and TCE = 0.005 mg/L
State Water Quality Standards	UAC R317-2-14	Establishes surface water quality standards.	Applicable	Applicable if groundwater discharges to surface water. Levels are based on surface water use designation (classification)
Groundwater Quality Standards	UAC R317-6	Establishes groundwater quality standards (UAC R317-6-2) and groundwater classes (UAC R317-6-4).	Applicable	Groundwater quality standards (R317-6-2) are applicable corrective action cleanup levels for contaminated groundwater under R317-6-6.15.7. These standards are the same as primary drinking water standards with few exceptions.

Standard, Requirement, Criteria or Limitation	Citation	Description	ARARs Determination	Comment
Federal Regulations				
Air Regulations				
Standards of Performance for Stationary Compression Ignition Internal Combustion Engines	NSPS 40 CFR Part 60 Subpart IIII	Establishes emissions standards and operational requirements for compression ignition internal combustion engines.	Applicable	It is unlikely that any remedial alternative would require stationary engines, since electricity from the power grid is readily accessible at the site. However this rule is applicable if an emergency generator is include as part of the remedial alternative.
Standards of Performance for Stationary Spark Ignition Internal Combustion Engines	NSPS 40 CFR Part 60 Subpart JJJJ	Establishes emissions standards and operational requirements for spark ignition internal combustion engines.	Applicable	It is unlikely that any remedial alternative would require stationary engines, since electricity from the power grid is readily accessible at the site. However this rule is applicable if an emergency generator is include as part of the remedial alternative.
National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines	NESHAP 40 CFR Part 63 Subpart ZZZZ	Establishes national emission limitations and operating limitations for hazardous air pollutants (HAP) emitted from stationary reciprocating internal combustion engines (RICE)	Applicable	It is unlikely that any remedial alternative would require stationary engines, since electricity from the power grid is readily accessible at the site. However this rule is applicable if an emergency generator is include as part of the remedial alternative.
State of Utah Regulations				
Air Regulations				
General Requirements for Air Conservation.	UAC R307-101	Outlines general requirements for Air Conservation.	Applicable	Compliance with National Ambient Air Quality Standards required for treatment process that emit contaminants into air. Includes definition of Air Conservation.
Non-Attainment and Maintenance Areas for PM10: Fugitive Emissions and Fugitive Dust.	UAC R 307-309	Specifies requirements for fugitive dust control in Davis County.	Applicable	This requirement is applicable to activities that could result in dust (e.g., construction, excavation).
Fugitive Dust Control Requirements for Construction and Demolition Activities	UAC R307-205-5	Fugitive dust must be minimized for all construction and demolition activities that require clearing or leveling of land greater than one-quarter acre in size or movement of construction equipment and trucks over access haul roads for any construction or demolition site.	Applicable	All alternatives must be designed to minimize fugitive dust and emissions. Applicable to remedial alternatives that may require soil disturbance such as drilling, land clearing, excavation, or construction activities.
Approval Order Requirement	UAC R307-401-8	Requirements for BACT and compliance with National Primary and Secondary Ambient Air Quality Standards.	Applicable	These requirements are applicable to air emissions, including emissions from any treatment systems.

Standard, Requirement, Criteria or Limitation	Citation	Description	ARARs Determination	Comment
Air Strippers and Soil Venting Projects	UAC R307-401-15	Emissions from Air Strippers and Soil Venting projects are exempt from approval order requirements under certain conditions.	Applicable	Emissions are exempt from approval order requirements of UAC R307-401-8 if certain conditions are met.
Environmental Response and Remediation				
Corrective Action Cleanup Standards - UST and CERCLA Sites	UAC R311-211	Addresses cleanup requirements at CERCLA and UST sites. The rule lists general considerations for establishing cleanup standards including MCLs in the Safe Drinking Water Act and air quality standards in the Clean Air Act. In addition, cleanup standards must be protective of public health and the environment, and prevent further degradation of site conditions. The rule also requires source elimination and prevention through removal or appropriate source control.	Applicable	Applicable to all alternatives.
Solid and Hazardous Waste Regulations				
Identification and Listing of Hazardous Waste	UAC R315-1 and R315-2	Outlines general requirements and provides definitions for Utah Solid and Hazardous Waste Rules. Defines those solid wastes that are subject to regulation as hazardous wastes.	Applicable	General rules and definitions will be applicable to management of generated hazardous wastes. Applicable for determining which wastes from remedial activities are hazardous and potentially subject to the hazardous waste management requirements under UAC R315. Potential hazardous wastes include, but are not limited to, drill cuttings from well installation, excavated contaminated soil, and contaminated groundwater extracted for treatment.
Hazardous Waste Generator Requirements	UAC R315-5	Outlines requirements for hazardous waste generators.	Applicable	Requirements would be applicable for hazardous waste generated as a result of cleanup activities (e.g., soil excavated during drilling or trenching activities and spent carbon from groundwater treatment units if these wastes are listed, contained-in, or exhibit a characteristic of hazardous waste).

Standard, Requirement, Criteria or Limitation	Citation	Description	ARARs Determination	Comment
Use and Management of Containers	UAC R315-8-9	Requirements for storage of hazardous waste in containers. Requirements include inspections, secondary containment, compatibility of waste with container, and handling of containers	Applicable	Applicable for any containers used to store hazardous wastes generated and managed on-site during remedial activities beyond the temporary storage allowed under R315-5. Includes but is not limited to, contaminated drill cuttings from well installation; excavated soil; and wastes (carbon, resin, etc.) produced by groundwater treatment activities.
Standards for Owners and Operators of Treatment, Storage, and Disposal Facilities	UAC R315-8	Outlines requirements for hazardous waste treatment, storage, and disposal facilities (TSDFs). Sate analog to 40CFR Part 264.	Applicable	Certain portions of the rule are applicable including any related to on-site management of listed, contained-in, or characteristic hazardous waste and also closure/post closure activities (R315-8-7).
Emergency Controls	UAC R315-9	Outlines requirements for emergency controls of hazardous waste spills. The rule specifies requirements for immediate action, cleanup and reporting for hazardous waste spills.	Applicable	The requirements would be applicable for any on-site hazardous waste spills during cleanup activities.
Clean-up Action and Risk-Based Closure Standard	UAC R315-101	Establishes requirements for managing sites contaminated with hazardous waste or hazardous constituents where cleanup to background will not be achieved. Site management depends on risks identified for the site and may include corrective action, post-closure care, monitoring, and institutional controls.	Applicable	Applicable to all alternatives.
Water Regulations				
Definitions and General Requirements	UAC R317-1	Provides definitions and general requirements for water quality.	Applicable	The provisions of the rule are applicable to activities involving surface or groundwater.
Ground Water Quality Protection Rule	UAC R317-6	Criteria for groundwater corrective action (R317-6-6.15) including design criteria (R317-6-6.15E.4b)	Applicable	Groundwater corrective action requirements apply to contaminated groundwater. Remedies should be designed so that wastes left in place will not result in discharges to groundwater in excess of groundwater quality standards.

Standard, Requirement, Criteria or Limitation	Citation	Description	ARARs Determination	Comment
Water Quality Standards	UAC R317-2	Establishes standards for the quality of source waters of the State. R317-2-6 defines use designations. R317-2-7 requires compliance with surface water numeric criteria. R317-2-213 classifies waters of the State. R317-2-14 provides numeric standards for water classes.	Applicable	Waters discharged into the storm sewer will meet the water quality standards contained in the city's storm water quality permit. Discharges to a POTW will meet pretreatment requirements of the POTW.
Underground Injection Control (UIC) Program	UAC R317-7	Sets standards and controls for the injection of fluids for subsurface emplacement. Rule prohibits injections that allow movement of contamination into underground drinking water sources and includes abandonment requirements for Class V wells.	Applicable	Applicable to alternatives that employed reinjection of treated groundwater or injection remediation agents such as those used in in-situ bioremediation or chemical oxidation. Subsurface environmental remediation wells are classified by EPA as Class V, Subclass 5B6.
Utah Pollutant Discharge Elimination System (UPDES)	UAC R317-8	Establishes standards and controls for discharges to surface water, including management of stormwater during construction activities, criteria and standards for technology-based treatment and best management practices, and pre-treatment requirements for discharge to a POTW.	Applicable	Applicable to remedial alternative that discharges to a surface water body or POTW. Best management practices will be used to control pollutants discharged to water of the State as, and to control stormwater discharge during and after construction activities. Waters discharged into the storm sewer will meet the water quality standards contained in the city's storm water quality permit. Any water discharged to a POTW will meet pretreatment requirements of the POTW.
Water Rights				
Well Drilling Standards	UAC R655-4	Establishes standards for drilling and abandonment of wells.	Applicable	Requirements are applicable for installing or abandoning of monitoring and/or treatment wells.

Table 15: Location-Specific ARARs

Location	Citation	Description	ARARs Determination	Comment
Federal Regulations				
Historic Preservation Regulations				
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts.	Archeological and Historical Preservation (16 USC Section 469 through 469c-1)	Provides for the preservation of historic or archaeological data that might be destroyed or lost as the result of (1) flooding, the building of access roads, the erection of workmen's communities, the relocation of railroads and highways, and other alterations of the terrain caused by the construction of a dam by any agency of the United States, or by any private person or corporation holding a license issued by any such agency or (2) any alteration of the terrain caused as a result of any Federal construction project or federally licensed activity or program.	Applicable	Applicable if scientific, historic, and archaeological artifacts are identified during remedial activities such as drilling or excavation. For all alternatives, measures would be taken to recover and preserve artifacts.
State of Utah Regulations				
Within an area where action may cause irreparable harm, loss, or destruction of significant artifacts	Utah Code Title 9, Chapter 8, Part 3 and UAC R455-4	Utah Code Section 76-9-704 prohibits disturbance of human remains, including ancient remains, on lands under State jurisdiction unless done in compliance with Utah Code Title 9, Chapter 8, Part 3 and R455-4	Applicable	Requires consultation with the Antiquities Section of Division of State History if remains or antiquities are discovered.
Nonattainment and Maintenance Areas for PM10 and PM2.5: Fugitive Emissions and Fugitive Dust	UAC R307-309	Establishes requirements for fugitive dust control. Opacity will not exceed 15% at property boundary and 20% anywhere on site. A fugitive dust control plan is required for clearing of 1/4 acre or greater.	Applicable	Davis County is a nonattainment area for PM2.5. This requirement is applicable to activities that could result in the emissions of fugitive dust (e.g., drilling, land clearing, excavation, etc.).
Ozone Nonattainment and Maintenance Areas (Handling of VOCs)	UAC R307-325	Requires that no person shall allow or cause VOCs to be spilled, discarded, stored in open containers, or handled in any other manner that would result in greater evaporation of VOCs than would have if reasonably available control technology (RACT) had been applied.	Applicable	Davis County is a maintenance area for ozone. PCE and TCE are considered VOCs when emitted to air as vapor, and VOCs are precursors to ozone. This rule is applicable to alternatives that could produce PCE or TCE vapors such as air strippers, or above ground storage of contaminated groundwater.

Appendix A: Responsiveness Summary

Five Points PCE Plume NPL Site
Responsiveness Summary

Overview:

The selected remedy for addressing PCE contamination in groundwater is Extraction, Containment, and Treatment at Plume Core and at Plume Toe; and institutional controls. The principal factors considered when choosing the selected remedy were: 1) reduces contaminant volume; 2) provides hydraulic containment at both the plume core and plume toe; 3) prevents further migration of PCE contaminated groundwater; 4) meets RAOs sooner than the other alternatives that were considered; and 5) uses relatively simple and effective technology and treatment components. ICs restricting the drilling and installation of new groundwater wells along the projected path of the groundwater PCE plume until remedial action objectives and clean-up goals are achieved will be established as part of this selected remedy.

Background on Community Involvement:

The Proposed Plan for the Five Points PCE Plume Site in Davis County, Utah was made available to the public in July 2015. The Proposed Plan, Remedial Investigation Report and Feasibility Study Report can be found in the Administrative Record file and information repository at the Davis County Library, South Branch; Utah Department of Environmental Quality, Division of Environmental Response and Remediation; and EPA Region 8 Records Center. The notice of the availability of the Proposed Plan was published in the Deseret News and Salt Lake Tribune on July 31, 2015 and in the Davis County Clipper on August 6, 2015. In addition to these newspapers a notice of the Proposed Plan availability and public meeting was also placed in the Woods Cross City Community Newsletter and on the North Salt Lake City and Woods Cross City web pages.

The UDEQ and EPA accepted comments on the Proposed Plan from July 31, to August 31, 2015. Two public meetings were held on August 19, and 20, 2015 in Woods Cross City and North Salt Lake City, respectively to present the Proposed Plan to the citizens of each community. The public comment period was extended from August 31, 2015 to October 5, 2015 after receiving a request for a 30 day extension from Woods Cross City and the City of North Salt Lake on August 26, 2015.

Comments:

Summary of Comments

During the public comment period, concerns were expressed regarding beneficial use of extracted groundwater and potential use of a municipal drinking water well as an extraction well at the toe of the groundwater plume. Weber Basin Water Conservancy District provided comments related to water rights and South Davis Sewer District provided a comment regarding impact fees for discharging extracted groundwater to their sewer collection system and treatment facilities. The UDEQ Division of Drinking Water commented that the preferred alternative was the best approach to remediating the contamination.

Public Comments and Agency Responses

Received from Gregory Dayley

1. Comment: I was reading the proposed plan and noticed the PCE Water Treatment Plant constructed by Woods Cross City is not mentioned. And that Woods Cross City well #4 is inactive, however, it was reactivated after the PCE Water Treatment Plant was constructed.

Response: The Woods Cross City Water Treatment Plant was mentioned in the Proposed Plan under the heading "Site Characteristics". The reactivation of Woods Cross well #4 is duly noted. The Proposed Plan Figure 1-2 does indicate Woods Cross Well #4 is not in use; however, it should be noted that Figure 1-2 was prepared as part of the Remedial Investigation when this was the case. The intent of Figure 1-2 was to convey the extent of the PCE groundwater plume.

2. Comment: Since the UDEQ/EPA wants to spend $3 million to $9 million why not pay Woods Cross City for their PCE Water Treatment Plant?

Response: The UDEQ and EPA have specific legal and technical requirements to access financial resources and were not able to subsidize the Woods Cross City Treatment Plant. Although Woods Cross City built the treatment plant to prevent PCE from entering the drinking water supply, the UDEQ and EPA Proposed Plan alternative is necessary to permanently remove PCE from the affected aquifer. The Woods Cross Treatment Plant does remove a limited amount of PCE from the aquifer, just not enough to be considered a long-term cleanup solution for the PCE plume.

Also, to warrant EPA action on the impacted drinking water wells, PCE concentrations would have to increase and exceed state and federal drinking water standards before UDEQ and EPA could access emergency financial resources. Woods Cross City looking towards future water needs conducted extensive community outreach before making the decision to treat drinking water. The City felt community feedback wanted no PCE in their drinking water, even at acceptable levels of PCE according to health risk, and moved forward with building the treatment plant (see comment 15).

Received from Cal Bench

3. Comment: With all the fresh Rocky Mountain spring run off water why do we need to save this water in the plume? We live near the Rocky Mountains and should be drinking fresh water from streams. Why not seal the plume off and not permit wells at all? Why can't the superfund money be used to bring fresh water to Woods Cross without the Bountiful flouride. I would drink fluoride. I know that it was voted down long ago. Flouride is known to be safe. I lived in Rose Park. Our water was delicious and cold. It came from City Creek. With Millions of super fund money I want fresh cold water.

Right now when I turn on our tap, I smell bleach. I taste warm bleach water. Our home is near the core. We have lived here since 1976. I have severe multiple kidney stone since I was 50 years old. I cannot metabolize protein, so I have a stiff heart. I have REM behavior disorder that started when I was 50. I have many rare disorders. I think they are related to drinking the water. I think that with the size of plume, it was likely the refineries including Hatcho that caused this. Dry cleaning solution is a byproduct of refining of crude oil. It is used by refineries to clean their large holding tanks. With all these tanks nearby, why are we not just sealing off the plume? With all of the ground water in other areas, do we really need wells in Woods Cross. The water under Woods Cross is less than a drop in the bucket of water available.

Response: Municipal drinking water providers such as Woods Cross City and the City of North Salt Lake are required to test and provide safe drinking water to their residents. The UDEQ and EPA are not aware of any occurrence where PCE levels in drinking water would have been considered harmful to individuals at the Five Points Site. The UDEQ and EPA completed an investigation to determine the cause of groundwater contamination. This investigation found that Your Valet Dry Cleaners is the likely cause of ground water contamination.

Received from the City of North Salt Lake

4. Comment: The proposed remediation plan of containment and reduction by pump and waste is a plan that can be supported by the City.

Response: Duly noted, thank you.

5. Comment: As opposed to sending the extracted water from the well at the toe of the plume to the sewer plant, the city proposes that the extracted water be introduced into the city's storm sewer system which is less than a half mile from the toe of the plume. This water would then transport to an area on Cutler Drive in the Foxoboro neighborhood where the water could then be utilized to revitalize a suffering wetland area. This water would provide a source of water for a new wetland ecosystem that would provide a environment suitable for wetland flora and fauna. The area under consideration is designated as a wetland but really does not have enough water to thrive and provide ecological benefits of a healthy wetlands. 300 gpm would provide a flow sufficient enough to sustain the water features needed in a thriving, healthy wetlands.

Response: The UDEQ and EPA will evaluate this proposal as a component of the selected remedy during the design of the remedy.

6. Comment: If GAC were installed the city would be willing to provide the water rights for the well at the toe of the plume. The City would not be able to provide rights if the resulting water at some time could not be used for culinary purposes should the need arise.

Response: The UDEQ and EPA appreciate the City of North Salt Lake's willingness to provide water rights and will work with the City when designing the selected remedy.

Received from Jim Martin, UDEQ Division of Drinking Water

7. Comment: Based upon my review of the information regarding the proposed action Alternative 4 - Containment at Plume Core and Plume Toe (The preferred alternative) is the best approach to remediating the contamination. This alternative should prevent human exposure to the PCE at levels above the MCL, prevent further migration of the plume and further contamination of a valuable source of drinking water, and restore the groundwater for future use as a source of public drinking water.

Response: Duly noted, thank you.

Received from Woods Cross City

8. Comment: Woods Cross City appreciates the efforts of EPA and UDEQ regarding the 5 Point PCE Plume Superfund Site. We feel the remediation at this site is of great importance to both the cities of North Salt Lake and Woods Cross and because it is such, we are working jointly on the response to the proposed cleanup plan. We feel the final remedy for the site needs to ensure our limited water resources are utilized in the best possible manner. We are currently working together to evaluate your proposal with this in mind.

We need additional time to properly evaluate all of the variables associated with your proposed plan and therefore, on behalf of Woods Cross City and the City of North Salt Lake, I am requesting a 30 day extension of the comment period. Consideration of this request would be greatly appreciated.

Response: The public comment period was extended an additional 30 days after receiving this request.

Received jointly from Woods Cross City, the City of North Salt Lake, Weber Basin Water Conservancy District, and South Davis Sewer District

9. Comment: Alternative 4, the preferred alternative, has two parts, containment at the toe of the plume and containment at the plume core. Both containment strategies include the drilling of wells, extraction of the contaminated water, treatment of the water and discharge to the South Davis Sewer District. The cost estimate for this alternative does not include the costs of water rights as outlined in the attached letter from the Weber Basin Water Conservancy District, and impact fees charged by the South Davis Sewer District as stated in the attached letter from the South Davis Sewer District. Furthermore, the proposed location of the well and treatment facility to extract water from the plume core is in a residential neighborhood with no vacant property for the facilities. The cost of procuring property for the needed facilities in this area is not included in the cost estimate. Taking these additional costs into account, Woods Cross City and the City of North Salt Lake would like to propose a partnership where the cities' existing water rights are utilized, the water extracted out of existing wells at the toe of the plume, a new well drilled at the plume core, treated to municipal standards and utilized in the municipal culinary water system. This would eliminate the cost of purchasing additional water rights, the impact fee costs to the South Davis Sewer treatment plant, and will put the water to a beneficial use.

The only apparent drawback to this approach as stated in the feasibility study report is the difference in the desired treatment levels of the cities and USEPA /DEQ. The solution to this drawback is to have the municipalities cover the incremental cost to treat the water from the level desired by USEPA /DEQ to the level desired by the municipalities.

Response: The UDEQ and EPA appreciate the willingness of Woods Cross City and the City of North Salt Lake to provide water rights for extraction of contaminated groundwater. UDEQ and EPA will evaluate the use of existing wells at the toe on plume and treatment of extracted water to Federal and State drinking water standards during the design of the selected remedy.

10. Comment: The City of North Salt Lake would like to propose an Alternative 2a, specifically for work at the toe of the plume. We will refer to the proposed alternative at the plume toe as 2a, in correlation with the combination of Alternatives 2 & 3 to create Alternative 4 in the Proposed Plan.

The revised alternative will still consist of hydraulic containment at plume toe, but will use the existing Freda Well in lieu of drilling an extraction well. The extracted water would be treated with granular activated carbon (GAC) to drinking water standards, and put to beneficial use in the culinary drinking water system.

Response: The UDEQ and EPA will evaluate the proposal to use the Freda Well in lieu of drilling an extraction well and treating extracted groundwater with GAC to Federal and State drinking water standards during the design of the selected remedy.

11. Comment: Water Rights Needed for the Proposed Wells: Alternatives 2-5 each include the drilling and pumping of at least one new groundwater extraction well. Each of these proposed wells will require a water right to allow water to be pumped from the aquifer. The East Shore area of the Great Salt Lake is currently over-appropriated and is closed to any new appropriations of ground water. Therefore, it will require that EPA/UDEQ acquire an existing water right within the immediate area and file a change application with the State Engineer's office to move the water right to the proposed points-of-diversion. In the South Davis area, ground water rights, available for purchase, are very hard to come by, but if there were some available our experience is that they would cost between $3,000-$6,000 per acre-foot. At a discharge rate of approximately 500 gpm, that would require an annual volume of 800 acre-feet of water or cost of between $2.4 - $4.8 million to purchase those rights. Groundwater levels have been receding in the East Shore area due to the area being over-appropriated—meaning there have been more water rights issued than the safe yield of the aquifer can sustain. An additional 800 AF would only worsen the decline, adding to the cost of equipment and energy required for existing right holders to pump their water to the surface. This added burden should also be taken in account when considering the total cost of this cleanup effort.

The water right must also outline the beneficial use that the water will be put to, which in this situation seems somewhat questionable.

Response: The UDEQ and EPA appreciate the information concerning the availability and cost of water rights. Woods Cross City and the City of North Salt Lake have expressed a willingness to provide UDEQ and EPA with a water right for extraction of groundwater in exchange for returning the extracted groundwater to a beneficial use.

12. Comment: Cost of Purchasing Drinking Water to Replace the Ground Water Sources: It may be possible for EPA/UDEQ to exchange water with the municipalities for the 30 year term. In other words, use a portion of their water right for the extraction wells and replace a like amount of water by purchasing treated drinking water from the District. The current wholesale water rate for the District's treated water is $546 per acre-foot per year. This would cost $436,800 per year or over $13 million over the course of 30 years. The District feels there are much more effective and efficient ways to affect the PCE cleanup in the South Davis area with existing wells and water rights, while putting the pumped water to its best beneficial use by the municipalities. We would welcome the chance to meet and discuss this plan with you and your colleagues.

Response: Duly noted, thank you. The UDEQ and EPA welcome the opportunity to work with Weber Basin Water Conservancy District, Woods Cross City and the City of North Salt Lake, during the design of the selected remedy.

13. Comment: In reviewing the Proposed Plan for the Five Points PCE Plume Superfund Site, it appears that the impact fees and annual user fees for discharging to the South Davis Sewer District collection system and treatment facilities were not included in the analysis. The following table summarizes the impact and user fees for the discharge volumes proposed in the Plan.

Discharge gpm	Discharge gal/day	EDU*	Impact Fee/EDU-$	Impact Fee $	User Fee EDU-$	User Fee $
200	288,000	1,029	$1,596	**$1,641,600**	$60/year	**$61,714**
300	432,000	1,543	$1,596	**$2,462,400**	$60/year	**$92,571**
500	720,000	2,571	$1,596	**$4,104,000**	$60/year	**$154,286**

*EDU-Equivalend Dwelling Unit at 280 gal/day/EDU

Response: Duly noted, thank you. Changes in the cost elements are likely to occur during the design of the selected remedy. Costs developed for the Feasibility Study and Proposed Plan were an order-of magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

Received during the August 19, 2015 Public Meeting

14. Comment: Have UDEQ and EPA considered injecting water extracted at the core well back into the ground?

Response: The UDEQ and EPA did not consider this scenario and would prefer to see extracted, treated groundwater returned to beneficial use at the surface.

15. Comment received from Woods Cross City Mayor Rick Earnshaw: The City has been very proactive ever since we have discovered the plume and how it was impacting our city's water. We shut down Well No. 1 and we have had the expense of drilling additional wells to meet our needs. Our water system is self-contained within our city. We get no outside water.

The city had public hearings to decide if water rates should be raised in order to build a treatment plant for addressing PCE contamination in groundwater. The citizens of Woods Cross voted in favor of raising their water rates to pay for the treatment plant which has been built and is currently treating water.

Is it then possible to draw the plume, treat the water and be able to use it instead of disposing of the water at the sewage plant? My next question is, if that proves to be an option and the fact that we already have a treatment plant with charcoal filters, then could the city receive funding to help pay off some of the bonds used to build the treatment plant?

Response: The UDEQ and EPA will work with Woods Cross City during the design of the selected remedy in order to determine a beneficial uses for extracted groundwater. As for funding assistance, EPA and UDEQ want look for any and all opportunities for efficiencies to minimize costs and reduce the financial burden on the community (see comment 2).